THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

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PRE-EMINENCE AND PROSPERITY.

FOLLOWING up a memorandum issued by the Commercial, Labour, and Statistical Department of the Board of Trade in 1897, Sir Alfred Bateman, the Controller-General, has recently published an examination of the trade of those four countries which are now engaged in a struggle for the markets of the world—the United Kingdom, France, Germany, and the United States of North America. The document is of absorbing interest by reason both of its actual contents and of the lines of thought to which it gives rise, while it is capable of exerting two very different effects upon the student, according to the mental attitude he adopts in reading it. With a pessimism that seems to be characteristic of latter-day journalism—a pessimism which is not free from offence, though undoubtedly better than blind optimism—many of our newspapers agree in thinking the report, or the state of affairs it illustrates, humiliating to the nation; and in that view they find, we cannot help regretting to see, an apparent advocate in Sir Alfred Bateman himself, who, in the course of his concluding remarks, observes, "We can scarcely expect to maintain our past undoubted pre-eminence, at any rate without strenuous effort and careful and energetic improvement in method."

Before accepting the guidance of the journalist who at one moment acclaims the Empire on which the sun never sets, and at another hints that we are about to follow the footsteps of that nation from whom we have borrowed the phrase, it may be well to look at the position we occupy in comparison with our competitors somewhat more closely, to see if we have much actual cause of complaint, to see if, perchance, we are not despising the attainable for the sake of the unattainable. Prosperity we may deserve and achieve; pre-eminence may be no longer within our grasp. Prosperity is largely the fruit of a man's own labour; pre-eminence is often due to lack of rivals. In the annexed table we give in quite round numbers the area, total population, and population per square mile of the four countries under review; figures we are prone to forget in moments of elation:—

Country.	Area in square miles.	Total population.	Population per square mile.
United Kingdom	121,000	38,000,000	314
France	204,000	39,000,000	191
Germany	211,000	52,000,000	247
United States	3,000,000	63,000,000	21

Omitting the colonies and dependencies, our country is the smallest of the four, not much more than half the size of Germany; we and France have the smallest population, and we are by far the most thickly populated. We are also much older than any of the others in political and industrial development. By virtue of our geographical situation and figure, our climate, and our political institutions, we were a busy commercial nation centuries before France and what is now Germany were anything but armed camps, ages before the United States existed. Comparatively few years ago we were doing

nearly all the export trade, most of the import trade, and the whole of the carrying trade of the world. It was, therefore, impossible for us to have increased our supremacy, and without the proof of statistics it might be imagined equally impossible for us to have retained it, or to have increased the volume of our trade except as the markets grew. And when the other nations awoke, not only were their first advances expressed as percentages, vastly superior to ours, as the infant grows faster than the youth; but roughly speaking their every gain was at our expense, and their individual progress but one-third of our loss. The day has now come when our competitors' figures are not merely better than ours when put in percentage form, but in some trades are larger than ours in absolute units. Is this surprising, is it excuse for crying *Ichabod*? Can a country of 121,000 sq. miles always expect to do a larger agricultural and mineral trade than one of 200,000 or 3,000,000? Can 38 million men compete in volume of commerce with 52 or 63? Moreover, have we not been drawing upon our stores of coal and iron until they are more costly to win than the practically untouched deposits of the Continent and America; and can we avoid leaving to our rivals the advantages of cheap raw materials till equilibrium is once more attained? Surely it is nothing but national conceit for us always to hope for pre-eminence: enough for Englishmen to ask for prosperity and progress.

If we turn to Sir Alfred Bateman for information on this point, we find him saying, "The figures show we have not stood still. They show we have progressed, although Germany and the United States have progressed more rapidly; but they do not show any displacement of the export trade of the United Kingdom by any one of our three principal competitors." Is not this prosperity? Again, Sir Alfred: "The exports per head in the United Kingdom are far in excess of what they are in either France or Germany, and are still more in excess of what they are in the United States; while the imports of the United Kingdom per head are more than double those of any of the other three countries—nearly five times the imports per head of the United States—and none of the countries named are gaining on the United Kingdom in this respect." Is not this progress? Assuredly that is the proper way to judge of the position—trade per head of the population, not trade per country, when the units both of population and of area are so divergent; exports and imports per head; and Sir Alfred says we are holding our own.

And yet it is certain that the combined manufacturing capacity of the four great industrial nations is growing out of proportion to the increase in the markets of the globe, so that competition must be even more severe in the future. We may let our pre-eminence pass with only the sigh of pride—we must; but we may have to fight hard to retain our prosperity. There is, however, a pre-eminence which it is still within our ability to hold; a pre eminence in quality. It is not ours to supply even our fellow-countrymen with corn and meat; it is no longer ours alone to supply the world with coal, iron, and manufactured goods; it may elude our power to undersell the foreigner. But so long as we act honestly by our customers, giving them the best value for their money, paying cash for what we buy, so long as our products are cheaper to use in the long run, because they are more solidly made, so long as we refuse to capture a new market by promises incapable of fulfilment, by samples superior to future deliveries; so long shall we be prosperous, and if not pre-eminent, pre-eminent in prosperity. There is a demand nowadays for cheapness at the expense of permanence—a demand which many manufacturers in foreign lands are hastening to meet, and we are losing orders. The reaction will come; and when it comes, unless we succumb to the disease meanwhile, we shall reap the benefits of our old-time reputation for good workmanship. As long as we deserve the pick of the world's orders, we shall receive them, even if foreigners get the bulk; and what time we have the best, no man shall weep the decline and fall of the British Empire.

Consular Reports.

Most of our readers will agree with us that the information which is contained in reports from British Consuls on the question of trade outlooks is of precious little use, its main deficiencies being that the details are incomplete, and that they reach the manufacturers' hands too late. In an excellent criticism of the British system—which he describes as an "absurd anachronism"—Mr. J. William Whittall, president of the British Chamber of Commerce of Turkey, handles it very severely. In his letter to the *Times* he brings the whole weight of his half-century's commercial experience in Turkey against our present way of doing things, and makes a sweeping comparison with the German Consular system, much to our disadvantage. We quote a few of his remarks:

"The German Consular official waits upon his country's trade as a commercial traveller waits upon his buyers. The British official sits in lordly majesty in his office, and expects British trade to wait upon him, the natural consequence being that he knows very little of what is going on, and of what he ought to do to promote British trading interests.

"Another point is that the German Consul is bound by the requirements of the German system to furnish constant—I am told fortnightly—reports on everything going on in his sphere, down to trivial details. These reports are sent to the central department at Berlin, the officials of which are bound to transmit all the recommendations to the proper quarter, whether to the Foreign Office, or the rail or steamer directors, or the special manufacturers, or, in fact, any one on whom pressure could be brought to bear for the furtherance of German trade.

"What is our British system? So far as I know, it consists in the Consul sending a yearly report to the Foreign Office, which deals chiefly with generalities, and which, as often as not, is not read, and most certainly is never acted upon, for there is no one whose business it is to see that it is pressed home and acted upon."

These strictures were fully borne out by the articles which we published a few weeks ago on "The Britisher Abroad" and "The Britisher at Home" (Elec. Rev., May 16th and June 6th).

A nation of shopkeepers must not leave too much to the men behind the counter. We must have our trade reporters all over the world; and the British Government ought to shake off its lethargy, and see that the matter is more efficiently and promptly attended to. Most of our leading manufacturers have appointed, or are appointing, their own representatives in the more important quarters of the globe; but, naturally, it is quite impossible for them to at one time cover so large an area as can be controlled by a Government organisation, though they certainly seem to do it more satisfactorily, notwithstanding the supposed better position of the Consul for obtaining information. Often enough, we are inclined to believe, the right men are not selected to send home these consular reports. Individual enterprise on the part of the manufacturer and merchant, should be supported and supplemented by greater assistance from the Government. In the Foreign trade of the future, as we have shown in the preceding article, there will

be most deadly rivalry, and the British manufacturer is fully justified in demanding that so important a matter as the consular trade reports should not be left to shuffle along attending to itself in a sleepy dreamy fashion. That there is room for betterment, no one can deny, and the need for enlightened and progressive action is becoming more pressing every day.

The Value of Mathematics to an Engineer.

Every engineer should obtain such a knowledge of mathematics as comes within the compass of his attainments, but for the majority of engineers the higher mathematics are not required, and it is a waste of time to labour too closely at mathematics when other studies are in hand that are of more value. We say more value because, in the large majority of cases, engineers are such that they must live by their engineering, and a man who has no private means cannot afford to refuse an income on which he can live in order that in two years' time he may earn twice that income. It is a fact that students at technical colleges, as stated by a recent correspondent, are often choked off by the attitude of professors who seem to think they have done their duty if they have covered a black-board with cretaceous hieroglyphics, badly drawn, and imperfectly explained.

There are not many places open for high-class mathematicians as such. The studies of the late Dr. John Hopkinson have done for electricity what cannot be again usefully accomplished, just as Dr. Joule is not really worth following in any fresh determination of the mechanical equivalent of heat. High-class mathematical determinations of bridge stresses are of very infrequent occurrence, and call for the services of very few men. There is no commercial demand for chemists competent to discover new elements. The list of "not wanteds" might be extended to considerable length. There still remains the fact that sound chemists, fair mathematicians, and safe experimentalists on commercial lines are required. We admit that employers, in their ignorance or greed, think it well to do without them, relying on being able to rub along by securing workmen from other firms. When so many firms are relying on others no better than themselves, it is no wonder that deterioration sets in.

Utilisation of Exhaust Steam.—A remarkable instance of successful reclamation of waste energy is described in a recent issue of *l'Industrie Electrique*. At the mines of Bruay, on the straits of Dover, the exhaust steam from the hauling engines had heretofore been allowed to escape to the atmosphere, the intermittent operation of the engines, and the difficulty of applying a sufficient expansion, rendering condensation impracticable. However, a Rateau steam turbine has been put down, which is driven by the steam from the low pressure cylinder of the main engine, and is coupled to two dynamos of 100-kw. each. The turbine runs at a speed of 1,600 revs. per minute; it consists of seven discs, 90 cm. in diameter, fitted with vanes, the outer case being 110 cm. in diameter and 120 cm. long. The dynamos run at the same speed as the turbine, and generate current at a pressure of 240 volts.

The steam pressure on admission to the turbine is below that of the atmosphere; in trials made, it was found to be about 13 lbs. per sq. in. absolute. The turbine exhausts into a condenser at a pressure of 3 lbs. per sq. in. Under these conditions, an output of 310 E.H P. was obtained, with a consumption of 40 lbs. of steam per E.H.P.-hour, a much better result than had been anticipated.

In order to overcome the irregularity of the steam supply, due to the intermittent working of the main engines, a novel form of thermal storage was devised by M. Rateau. The apparatus consisted simply of an old boiler filled with several tons of scrap iron. In passing through this the steam gives up heat, falling for example from 105°C to 98°C; but when the main engines stop, the process is reversed, the condensed steam being re-evaporated. Provided that the stoppages of the main engines are not too protracted, a practically uniform supply of steam for the turbine is obtained by this means. When necessary, however, steam can be supplied to the turbine from the boilers, through a reducing valve.

It is interesting to speculate whether it would be possible to make use of the system more generally. It is well-known that it is not economical to expand steam below a certain pressure—approximately that which is necessary to overcome the friction of the engine. In the turbine, however, expansion can be carried to a much higher degree without disadvantage.

It is stated that trials made by M. Picou with the plant above mentioned, fully confirm this view. Although it would probably be impracticable to apply the system in any but a few instances, it is still worthy of note, especially having regard to the remarkably large output obtained.

Unfortunately, particulars of the size of the main engines and of the actual total cost of the energy reclaimed, are wanting.

THE OLD AND THE NEW ELECTRICAL THEORY.

By ALEX. P. TROTTER.

(*Continued from page* 245.)

Faraday had an instinctive dislike to the idea of "action at a distance;" it was a survival of the dogmas of the schoolmen by whom such principles as "Nature abhors a vacuum" were thrown off as lightly as cheap epigrams by a modern dramatist. The idea of *actio in distans* was retrogressive. Descartes held *Dari in Natura vacuum repugnat*, and was content to explain the gravitation of the planets, and the attraction of the lodestone, by "vortices" which contain the germ of Faraday's lines of force. *Causa aequat effectum* was another of these self-complacent dicta. Of this Prof. P. G. Tait writes:—"The fact is, we have not quite cast off that tendency to so-called metaphysics which has often completely blasted the already promising career of a physical inquirer. I say 'so-called' metaphysics, because there is a science of metaphysics; but, from the very nature of the case, the professed metaphysicians will never attain to it. In fact, if we once begin to argue upon such a dogma as the above (*causa aequat effectum*), the next step may be very naturally to inquire whether cause and effect are simultaneous or successive; and then we shall have become so mystified about the meaning of the word cause, that we may well be ready (as many have already done) to inquire what is the necessarily ever-acting cause of the uniform motion of a body on which no forces act. . . . . Within the last 50 years we have philosophers like Hegel saying that the motion of the heavenly bodies is not a being pulled this way or that; that they go along, as the ancients said, like blessed gods."

Faraday and His Lines of Force.

"I resolved," wrote Maxwell in his preface to "Electricity and Magnetism," "to read no mathematics on the subject until I had first read through Faraday's experimental researches on electricity. I was aware that there was supposed to be a difference between Faraday's way of conceiving phenomena, and that of the mathematicians, so that neither he nor they were satisfied with each other's language. I had also the conviction that this discrepancy did not arise from either party being wrong. . . . As I proceeded with the study of Faraday, I perceived that his method of conceiving the phenomena was also a mathematical one, though not exhibited in the form of mathematical symbols. I also found that these methods were capable of being expressed in the ordinary mathematical forms, and thus compared with those of the professed mathematicians. For instance, Faraday, in his mind's eye saw lines of force traversing all space, where the mathematicians saw centres of force attracting at a distance. Faraday saw a medium where they saw nothing but distance; Faraday sought the seat of the phenomena in real actions going on in the medium; they were satisfied they had found in it a power of action at a distance impressed on the electric fluids. When I had translated what I considered to be Faraday's ideas, into a mathematical form, I found that in general the results of the two methods coincided, so that the same phenomena were accounted for, and the same laws of action deduced by both methods, but that Faraday's methods resembled those in which we begin with the whole, and arrive at the parts by analysis, while the ordinary mathematical methods were founded on the principle of beginning with the parts and building up the whole by synthesis. . . . I also found that several of the most fertile methods of research discovered by the mathematicians could be expressed much better in terms of ideas derived from Faraday than in their original form."

The one act of imagination by which Faraday conceived the *space* surrounding a magnet or a wire carrying an electric current, to be full of "lines of force," gave him a concept on which all his work on electrical dynamics was founded. "By magnetic curves," explained Faraday in a footnote, "I mean lines of magnetic force . . . which would

* P. G. Tait, "Recent Advances in Physical Science" (1876), p. 11 and 7.

nearly all the export trade, most of the import trade, and the whole of the carrying trade of the world. It was, therefore, impossible for us to have increased our supremacy, and without the proof of statistics it might be imagined equally impossible for us to have retained it, or to have increased the volume of our trade except as the markets grew. And when the other nations awoke, not only were their first advances expressed as percentages, vastly superior to ours, as the infant grows faster than the youth; but roughly speaking their every gain was at our expense, and their individual progress but one-third of our loss. The day has now come when our competitors' figures are not merely better than ours when put in percentage form, but in some trades are larger than ours in absolute units. Is this surprising, is it excuse for crying *Ichabod*? Can a country of 121,000 sq. miles always expect to do a larger agricultural and mineral trade than one of 200,000 or 3,000,000? Can 38 million men compete in volume of commerce with 52 or 63? Moreover, have we not been drawing upon our stores of coal and iron until they are more costly to win than the practically untouched deposits of the Continent and America; and can we avoid leaving to our rivals the advantages of cheap raw materials till equilibrium is once more attained? Surely it is nothing but national conceit for us always to hope for pre-eminence: enough for Englishmen to ask for prosperity and progress.

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Faraday had an instinctive dislike to the idea of "action at a distance;" it was a survival of the dogmas of the schoolmen by whom such principles as "Nature abhors a vacuum" were thrown off as lightly as cheap epigrams by a modern dramatist. The idea of *actio in distans* was retrogressive. Descartes held *Dari in Natura vacuum repugnat*, and was content to explain the gravitation of the planets, and the attraction of the lodestone, by "vortices" which contain the germ of Faraday's lines of force. *Causa aequat effectum* was another of these self-complacent dicta. Of this Prof. P. G. Tait writes:—"The fact is, we have not quite cast off that tendency to so-called metaphysics which has often completely blasted the already promising career of a physical inquirer. I say 'so-called' metaphysics, because there is a science of metaphysics; but, from the very nature of the case, the professed metaphysicians will never attain to it. In fact, if we once begin to argue upon such a dogma as the above (*causa aequat effectum*), the next step may be very naturally to inquire whether cause and effect are simultaneous or successive; and then we shall have become so mystified about the meaning of the word cause, that we may well be ready (as many have already done) to inquire what is the necessarily ever-acting cause of the uniform motion of a body on which no forces act. . . . . Within the last 50 years we have philosophers like Hegel saying that the motion of the heavenly bodies is not a being pulled this way or that; that they go along, as the ancients said, like blessed gods."

Faraday and His Lines of Force.

"I resolved," wrote Maxwell in his preface to "Electricity and Magnetism," "to read no mathematics on the subject until I had first read through Faraday's experimental researches on electricity. I was aware that there was supposed to be a difference between Faraday's way of conceiving phenomena, and that of the mathematicians, so that neither he nor they were satisfied with each other's language. I had also the conviction that this discrepancy did not arise from either party being wrong. . . . As I proceeded with the study of Faraday, I perceived that his method of conceiving the phenomena was also a mathematical one, though not exhibited in the form of mathematical symbols. I also found that these methods were capable of being expressed in the ordinary mathematical forms, and thus compared with those of the professed mathematicians. For instance, Faraday, in his mind's eye saw lines of force traversing all space, where the mathematicians saw centres of force attracting at a distance. Faraday saw a medium where they saw nothing but distance; Faraday sought the seat of the phenomena in real actions going on in the medium; they were satisfied they had found in it a power of action at a distance impressed on the electric fluids. When I had translated what I considered to be Faraday's ideas, into a mathematical form, I found that in general the results of the two methods coincided, so that the same phenomena were accounted for, and the same laws of action deduced by both methods, but that Faraday's methods resembled those in which we begin with the whole, and arrive at the parts by analysis, while the ordinary mathematical methods were founded on the principle of beginning with the parts and building up the whole by synthesis. . . . I also found that several of the most fertile methods of research discovered by the mathematicians could be expressed much better in terms of ideas derived from Faraday than in their original form."

The one act of imagination by which Faraday conceived the *space* surrounding a magnet or a wire carrying an electric current, to be full of "lines of force," gave him a concept on which all his work on electrical dynamics was founded. "By magnetic curves," explained Faraday in a footnote, "I mean lines of magnetic force . . . which would

* P. G. Tait, "Recent Advances in Physical Science" (1876), p. 11 and 7.

be depicted by iron filings; or those to which a very small magnetic needle would form a tangent." So vividly did Faraday picture these lines of force that he was able to make his great discovery of electro-magnetic induction.

"It is narrated of him," writes Silvanus P. Thompson, "how at this period he used to carry in his waistcoat pocket a small model of an electro-magnetic circuit, a straight iron core about 1 in. long, surrounded by a few spiral turns of copper wire, which model he at spare moments would take out and contemplate, using it thus objectively to concentrate his thoughts upon the problem to be solved. A copper coil, an iron core. Given, that electricity was flowing through the one, it evoked magnetism in the other. What was the converse? At last, by sheer experimenting, he arrived at the notion of *cutting* the lines of force in space by a wire."

"The magnitude and originality of Faraday's achievement," wrote Clerk Maxwell, in the article on Faraday in the "Encyclopædia Britannica," "may be estimated by tracing the subsequent history of his discovery. As might be expected, it was at once made the subject of investigation by the whole scientific world, but some of the most experienced physicists were unable to avoid mistakes in stating, in what they conceived to be more scientific language than Faraday's, the phenomena before them. Up to the present time the mathematicians who have rejected Faraday's method of stating his law as unworthy of the precision of their science, have never succeeded in devising any essentially different formula which shall fully express the phenomena without introducing hypotheses about the mutual action of things which have no existence, such as elements of currents which flow out of nothing, then along a wire, and finally sink into nothing again."

"This notion of *cutting* the invisible magnetic lines as the essential act necessary and sufficient for induction was entirely original with Faraday. For long it proved a stumbling block to the abstract mathematicians, since there was, in most cases, no direct or easy way in which to express the number of magnetic lines that were cut."†

Faraday treated these lines of force as pure concepts. They were mere directions along which something called force acts. About this something Faraday made some speculations, but probably finding that he was being led away from experimental research, and was likely to be bogged in a quagmire of metaphysics, spent no considerable time on them.

"All that we know of atoms will be perfectly well accounted for if we dispense altogether with the notion of an atom—dispense with anything material in the ordinary sense of the word matter—but suppose merely a centre of force, such as we are accustomed to in those mathematical fictions which we meet with in our text-books. Suppose, in the place of an atom, a mere geometrical point which can exert either repulsive or attractive forces. . . . So far as external bodies are concerned, this will behave just as an atom would do. That explanation was taken up and developed to a great extent by Boscovich, and was, to a certain extent, adopted in later times even by Faraday.‡"

Current.

It is clear that Faraday's aim was to simplify as much as possible, and to retain as few concepts as possible.

There was one, however, which had already taken too firm a hold on electrical science—namely, that of current. He had, as we have seen, determined not to accept it as a dogma; science knows no dogma, for it acknowledges no authority. We recognise the presence of what is called an electric current only by a few impressions on our senses; we perceive that it produces heat, that it is accompanied by magnetism, and that under suitable conditions it is attended by chemical decomposition and certain optical effects. All these we perceive, but the current we do not perceive. It is nothing more than a concept, an abstraction, an idea. It would be easy to create any number of ideas to save ourselves the trouble of closer investigation into physical problems. We might account for the flow of water by its aquosity, or for the time-keeping quality of a clock by its horology, but that is not science. Clerk Maxwell speaks of "the exceedingly artificial hypothesis" of Fechner and Weber, "a combination of a current of positive electricity with an exactly equal current of negative electricity in the opposite direction through the same substance,"* and in the light of modern theory the single current is but a step less artificial. Oliver Heaviside is one of those who desires "to assist in abolishing the time-honoured but (in my opinion) essentially vicious practice of associating the current in a wire with the motion through the wire of a hypothetic *quasi*-substance, which is a pure invention that may well be dispensed with."† This is the answer by one of the leading electrical writers of the century to the interminably reiterated question, What is electric current? A pure invention that may well be dispensed with. "I am no believer in this fluid," writes the same author in another place. "Its only utility is to hang certain facts together. But when one has obtained an accurate idea of the facts, it has to hang together; it has served its purpose."

"The word *current* is so expressive in common language," wrote Faraday, "that when applied to the consideration of electrical phenomena we can hardly divest it sufficiently of its meaning, or prevent our minds from being prejudiced by it. I shall use it in its common electrical sense, namely, to express generally a certain condition and relation of electrical forces supposed to be in progression . . . . an axis of power, in every part of which both electric forces are present in equal amount."‡

The use of the word "Fluid," wrote Maxwell, "has been apt to mislead the vulgar, including many men of science who are not natural philosophers, and who have seized on the word fluid as the only term in the statement of the theory which seemed intelligible to them."§

We can never rid ourselves of the unfortunate word "current," and it will always carry with it the suggestion that there is something which flows. The hard-worked hydraulic analogy supports that suggestion, and when an ampere is compared with a rate of flow of so many gallons per minute, the student at once thinks that the element of time is comprised in the concept ampere. Further inquiry shows him that the gallon is the analogue of the coulomb, and he suspects that time is hidden twice over in the ampere-hour, and that it need not be there at all. It is commonly thought in this country that there is a redundancy in the French expression "l'intensite du courant." We borrowed the word current from the French, and failed to retain the true idea of an intensity.

(To be continued.)

Correction.—On p. 244, second column, line 55, for "lent" read "leant."

INDIA AS A FIELD FOR ELECTRICAL ENTERPRISE.

[From an Indian Correspondent.]

It is much to be feared that, in spite of the popular idea to the contrary, and of the speech by Lord George Hamilton some time since regarding the extension of industry in India by electrical means, the actual practical field is a very limited one. The reason for this is, that very few practical uses for power can be found within reasonable distances of the large waterfalls which exist in various parts of Hindustan, and electric lighting must of necessity be only confined to the large towns on account of the poverty of the people and their low standard of comfort. In Calcutta an electric lighting company is at work, and its success has been very great, but this has been chiefly due to the large use of electric punkahs (fans) which have been extensively substituted for the old system of punkah-pulling by coolies. The lighting part of this company's load is very small, except in the cold season, December and January, and is chiefly used by the Europeans. There is no doubt that if this company supplied lighting only it would not be possible to procure a

* "Michael Faraday, his Life and Work," by Silvanus P. Thompson, page 104.
† "Michael Faraday," S. P. Thompson, p. 134.
‡ P. G. Tait, "Recent Advances in Physical Science," p. 288.

* Clerk Maxwell, "Electricity and Magnetism," Vol. i., p. 289.
† "Electrical Papers," Vol. ii., p. 143.
‡ "Experimental Researches," Vol. i., 1,617, 1,642.
§ "Electricity and Magnetism," Vol. i., p. 38.

paying load, as the distances over which the mains have to be carried is so great, for there each house is situated in a large garden. This remark applies equally to all the provincial towns in India, and thus large capital requires to be laid out on mains which would not repay the interest on them unless some cheap form of overhead distribution be adopted.

There are a number of contracting firms now in Calcutta who carry out wiring of houses and fitting of electric punkahs, the number of which is still increasing. The electric tramways have recently started in that city, and have proved a great improvement over the old system of horse traction.

In Madras, the electric tramways have been working for some years, and after many troubles in the first instance owing to the adoption of an underground system, they are now working without difficulty by overhead construction. There is no public system of lighting in Madras, which still uses oil lamps everywhere, except a few isolated private plants, as, for example, at the telegraph office. It would seem possible that there should be a field for some lighting work if carried out in connection with the tramways system. The tramways are now in the hands of the Electric Construction Company, as the attempts to form a local company failed to raise the necessary capital.

In Bombay there is a large scheme for spending £1,000,000 sterling in both tramways and lighting, and negotiations are still in progress, but matters are at present at a standstill owing to litigation between the tramway company and the Bombay municipality. When these difficulties have been overcome there will be a large amount of work to be done in wiring and punkah supply, as in Calcutta, though there are four electrical firms now doing business in Bombay. There are a large number of private installations in Bombay, chiefly mills and large business firms. The Government Telegraph Department and the railway workshops, the cotton mills, the Royal Bombay Yacht Club, and a few firms, have their own plant.

The two principal power schemes are those on the Cauvery Falls, at Sivava Madrum, Mysore, and at Coonoor Cordite Factory.

Neither of these schemes have yet started work, but the former is now almost ready, and it is expected the work will be started on August 1st this year, when the Viceroy visits Mysore on the installation of the new Maharajah.

The overhead transmission line is complete, the plant is fixed in the power house, and the switchboard work in the transformer houses is now finished. The prospects of this scheme are exceptionally good, as the load is a perfect one, such as would rejoice the heart of any engineer, *viz.*—*24 hours a day and 365 days of the year!* the reason being that the Mysore Gold Fields are continuously at work without intermission, except for one day a month, when the stamps, &c., are cleaned.

The Kartari Falls, which will supply the cordite factory at Coonoor, have a head of 690 ft., but the volume of water passing in the hot season of April and May is very small, but will be sufficient for all the power required by the factory in all the processes of manufacture of cordite and other explosives.

Several schemes have been suggested—for example, the lighting of Simla, power being derived from waterfalls; the working of the Nilgiri Railway, near Coonoor, also by water-power—but the great defect in all these schemes is the want of definite load to repay the cost of the initial outlay; and this is just where all the schemes fail, although in the two schemes now being carried out the circumstances are exceptionally favourable for their success.

It would seem that the only field in which electrical work can be done will be the supply of plant by English manufacturers to contracting firms in the large towns for isolated electrical plants in clubs, mills, factories or elsewhere where there is a reasonable possibility of there being a remunerative load and an extensive system of distribution not necessary.

The fact that the whole of the plant at the Cauvery Falls works is entirely of foreign manufacture (American) again points to the necessity for the British manufacturer to study the requirements of the British colonies and dependencies, and endeavour to manufacture what is required. The principal reason apparently why this contract was placed with the American company was because they had had so much more experience in large power-transmission plant, and for similar reasons the turbines were obtained from the eminent Zurich firm (Escher Wyss).

The Government of India are taking active steps to introduce electric punkahs into India, more especially in the barracks of large military stations, intending to eventually abolish the punkah coolie entirely. They have recently had the expert opinion of Mr. A. H. Preece, who came out specially to report on this work, and they have also appointed a special Royal Engineer officer to give his attention to this question.

TUBE RAILWAYS.

By W. H. BOOTH.

When people give evidence for or against any project they are apt to make statements that do not bear examination. Thus, in evidence before the Committee on tube railways, one gentleman, doubtless in perfect good faith, stated that a tube railway under the Heath would damage the Heath, drain the subsoil, and injure vegetation. Now, what are the facts? It is proposed to bore the tube at a depth of 200 ft. Hampstead Heath is a heath because it is poor, barren, sandy soil; the capping of the hill at Hampstead, like that of Highgate: High Beach, in Epping Forest: Laindon Hill, in Essex: and Minster, in Sheppey, being the Bagshot sand, which also makes a waste of the New Forest, in Hampshire. At Hampstead this sandy capping is probably 80 ft. thick. Below it is the London clay, extending probably 360 ft., and there is a further 40 ft. of the plastic clay below this. Consequently any tube at a depth of 200 ft., as proposed, will be entirely in clay, which will close round the tube like putty, and is so dry that it is practically waterless, except in occasional lenticular beds of sand. To return now to the drainage of the subsoil, so much feared by the witness. The whole of the Bagshot on Hampstead Heath is so pervious to water that this sinks right through to the top of the London clay. The clay is impervious, and when the water gets down to the top of the clay, it travels along its upper surface and finally emerges into daylight at the junction of the clay with the sandy beds above, and it finds its way into Hampstead Ponds, which it leaves as the River Fleet and flows into the Thames under Blackfriars Railway Bridge. At least it does so when a sudden heavy rainfall enables the storm overflow to act. Otherwise it flows along the main sewer to Abbey Mills. A few months since it reasserted its title of a river by bursting into the railway in Farringdon Road, and filled it 18 ft. deep.

The subsoil of Hampstead Heath is, and has been, effectually drained by nature for probably thousands of years, and it is rather ignoring geological facts to come before a Committee and talk about draining Hampstead Heath, which is what it is, because it is of such stuff as is naturally drained. The tube railway cannot affect the welfare of a single sprig of moss on Hampstead Heath.

A LARGE INFLUENCE MACHINE.

By H. S. ALLEN.

The present article is a description of a large influence electrical machine of the Wimshurst type recently presented by Lord Blythswood to the Royal Infirmary, Glasgow. The machine is in all respects similar to four others constructed about 10 years ago in accordance with Lord Blythswood's designs. The objects kept in view in designing them were to secure adequate strength in the working parts, and easy manipulation in taking the machines to pieces for cleaning or repair. These four machines have been in constant use in the laboratory since they were made, and have never given the slightest trouble. As the requirements referred to seem to be conspicuously lacking in many of the machines on the market, while there is a probability that large machines of

this type have an important future before them, it has been thought worth while to publish a detailed description.

A general idea of the apparatus may be obtained from the photographs (figs. 1 and 2). The instrument has 40 plates, each 3 ft. in diameter. These are arranged in two sets on either side of the central column, each set containing 10 pairs of plates. The plates are driven by belts from pulleys on the lower shaft. Except at the ends of a set, each belt drives a pair of plates, and the alternate belts are crossed so that opposed plates rotate in opposite directions.

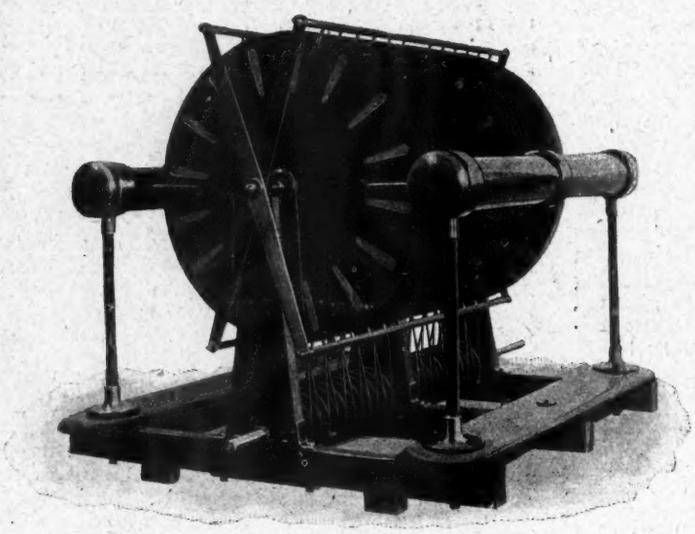


Fig. 1.—Complete Influence Machine.

The stand of the machine is shown, drawn to scale, in fig. 3. It is constructed of mahogany. The framework forming the base consists of two longitudinal beams, 4 in. deep and $2\frac{1}{2}$ in. thick, joined by three transverse ones having the same cross-section. Each of these transverse beams carries at its centre a vertical standard 28 in. high, to support the main shaft of the machine. The central standard alone is permanently fixed to the beam which carries it; those at the ends can be removed by unscrewing the brass knee pieces which fix them to the beams, and sliding them in a direction parallel to the shaft along wooden tongues fixed in the beams. In this way the shaft with the plates attached can be left supported by the central standard, and the plates themselves can then be slipped off the shaft for cleaning or repair.

On the top of each longitudinal beam rests a flat board 11 in. wide, running the whole length of the machine. These boards carry the stands of the prime conductors.

The machine has two steel shafts, the driving shaft and the main shaft which carries the plates. The former is 7 ft. long and $1\frac{7}{8}$ in. in diameter at the centre. At the ends it is turned down to $1\frac{3}{8}$ in. to fit the brass bushes which form its bearings. The bushes are fixed to the transverse beams, the base of each standard being provided with a hole large enough to admit them. One end of the shaft is left long enough to project through the case of the machine and carry a driving pulley. Each half of the shaft carries a set of 11 wooden pulleys, 8 in. in diameter and 2 in. apart. For simplicity each set of 11 pulleys is built up into a solid block (fig. 5).

The upper shaft is 5 ft. long and $1\frac{1}{2}$ in. in diameter in the central portion. The ends are turned down to $\frac{7}{8}$ in. for the bearings, and the extreme ends are screwed $\frac{3}{4}$ in. in diameter. The shaft is borne by three brass bushes fixed on top of the wooden standards already described. On this main shaft run the 22 brass pulleys which carry the plates of the machine. These are divided into two sets of 11 each on either side of the central standard. Every pulley except those at the end of each set carries two plates; the end pulleys, four in number, only carry a single plate.

The design and construction of these pulleys, and the method of attaching the plates to them, together constitute the most important mechanical feature in the whole of the work, for on these the machine depends for easy running and for durability. The usual plan of cementing the glass plates to a boss of wood or ebonite is only suited to machines of a small size.

One of these pulleys with its attachments is shown in fig. 4. The parts are all turned from brass castings. The pulley itself consists of a three-spoked wheel, 4 in. in diameter, with a hub in the form of a brass tube, 2 in. long. The inside of the tube is turned to fit the spindle; the outside is screwed at each end to receive the nut which secures the glass disc. The disc is held between the nut and the washer shown in the figure. A ring of cloth stamped to the proper size is fastened to the face of the nut, and another ring is fastened to the face of the washer so as to prevent contact between the glass and metal surfaces. With the same object the hole in the glass plate, 3 in. in diameter, is made larger than the corresponding fitting on the nut, and the space between is filled with a thick ring of vegetable fibre, which serves as a bedding for the disc. In order to obviate all risk of the nut becoming slack in consequence of any sudden jerk in the motion of the machine, a short steel pin is fixed into one of the spokes of the pulley and fits into holes in the washers, thus preventing any motion of rotation with reference to the pulley.

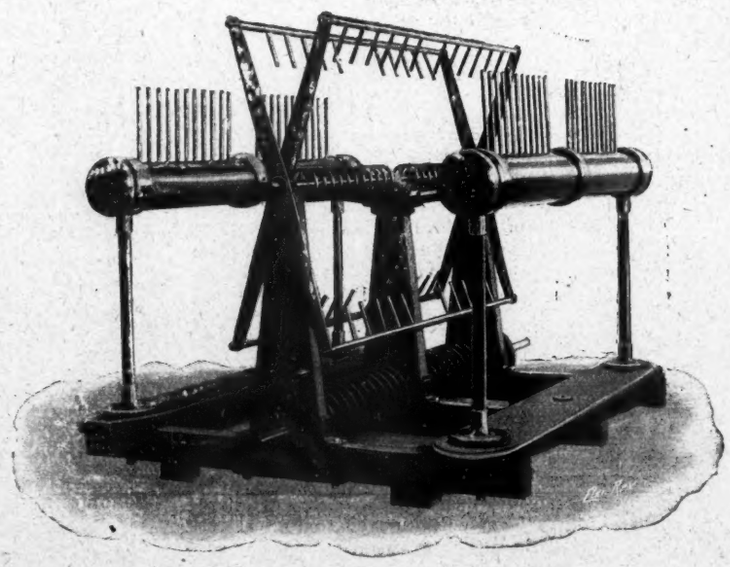


Fig. 2.—Influence Machine with Plates Removed.

As it is impossible to obtain all the glass discs of exactly the same thickness, the thickness of the washer may require to be diminished in some cases when the plates are fitted on.

To bind up the nut a simple key is required with two projecting studs fitting into holes in the face of the nut.

The glass used for the discs is described in the trade as selected flat 15 oz. sheet-glass, of British manufacture. It

was supplied in square sheets by Messrs. Malloch, of Glasgow. The first operation is to bore out a central hole 3 in. in diameter. A simple tool for the purpose may be formed from a short length of copper tubing of the required diameter by filing a number of notches round the circumference at one end of the tube, to form coarse teeth. This cutter may conveniently be mounted in a vertical drilling machine. In order to avoid breakages in the process of

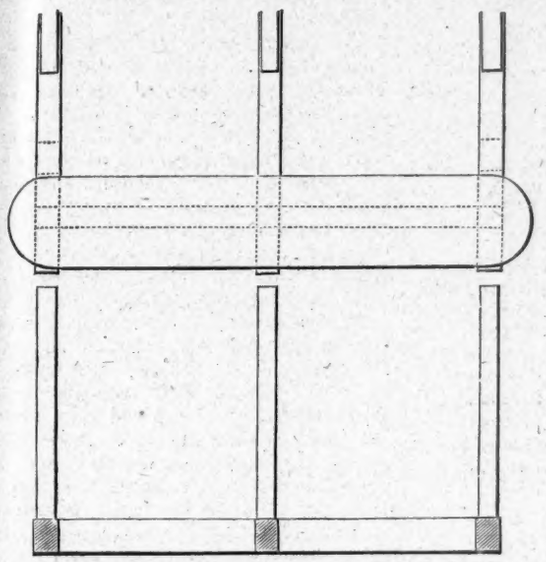


Fig. 3.—Section and Half Plan of Stand.

boring, care must be taken that the surface of the plate is exactly at right-angles to the axis of the cutter, and it is somewhat safer to use sand instead of emery. After it has been bored, a circular disc 3 ft. in diameter is cut from the plate with a glazier's diamond, by mounting it on a turntable. The edges of the plate are then ground to remove any sharp corners.

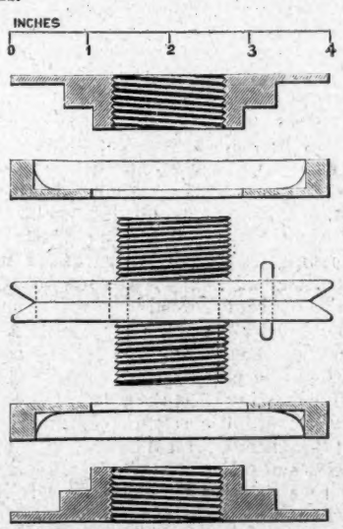


Fig. 4.—Details of Pulley.

The discs were carefully cleaned, and whilst warm were given two coats of varnish. The varnish was prepared by dissolving the best orange shellac in absolute alcohol and allowing the sediment to settle. A clear and transparent surface resulted from this treatment. Sixteen sectors of thin tinfoil were attached to one face of each plate. These sectors were 6 in. long and tapered from 1¼ in. wide at the broader end to ⅝ in. at the narrower end.

The arrangement of the neutralising brushes and of the prime conductors is best seen in the photograph of the machine with the plates removed. The neutralising brushes are carried on two pairs of brass tubes, 1 in. in diameter, extending the whole length of the machine. These tubes are supported by flat brass strips pivoted at their centres on the upper shaft, and so forming the arrangement in the shape of the letter X at each end of it. The angle between the limbs of the X may be adjusted so as to give maximum efficiency. The neutralising rods and their supports may be easily removed by unscrewing the nuts which secure them.

The prime conductors are large, so that their appearance may be in keeping with the rest of the machine. Each conductor rests on two varnished glass pillars 1½ in. in diameter, and is further supported by a glass stay, one end of which is fixed to the central standard of the machine. The conductor may be turned about a horizontal axis in the direction of its length, as may be seen from the photographs, so that the collecting combs may be turned aside out of the way of the plates.

The machine is enclosed in a glass case large enough to admit the entrance of a workman for the purpose of oiling or cleaning the parts. When the machine is at work, the air inside the case is being constantly changed by ventilating fans driven by the same motor (of about ¼ H.P.) that runs

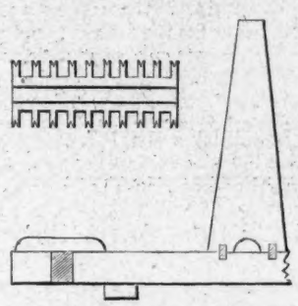


Fig. 5.—Elevation of Stand and Section of Driving Pulley.

the machine. It is advisable that the ventilating process should continue for some time after the excitement has ceased. The air supply is kept as far as possible dry and free from dust.

It may be of interest to add a few details as the performance of a machine of this size. Tested on a very damp day, it gave a torrent of sparks from 12 to 15 in. in length. When used to charge a large condenser of capacity approximately ·15 microfarad to a potential high enough to spark across a gap 7·5 mm. in length, it gave a spark once in every 6 seconds. If the discharge is taken between points instead of spheres, very fine brush effects are obtained by separating the terminals beyond the sparking distance, a feature which seems likely to render the machine valuable in therapeutics.

TRANSMISSION OF ELECTRICAL DISTURBANCES.

By Rankin Kennedy.

With many others I had a hope that Mr. Marconi, in his recent lecture on his space signalling experiments, would have at least attempted to explain how waves similar to light waves can be propagated round a corner.

It is easy enough to conceive of waves travelling in a straight line as light does, and even piercing brick walls, and no doubt, from the experiments of Hertz and others, there are many proofs that electro-magnetic waves are generated, under some conditions, which do travel like light in straight lines; but, fortunately for Marconi and others, there seems to be a transmission of electrical disturbances, oscillations, or waves, or whatever one may choose to call the phenomenon, which does not proceed like light, a mode of electrical transmission not yet dreamed of in the Maxwellian theory.

The moment Marconi proved that the earth's curvature did not impede his signals, the Hertzian wave theory became useless as an explanation of the results.

It may be enough for a practical man to be satisfied with the results, without inquiring too closely into the *modus operandi* of the system; but in this case we have had the

radiating theory so positively put forward, and the language of optical science persistently used to explain what proves to be nothing akin to light or heat radiations, and quite different from optical effects, that we naturally look for some explanation of the remarkable deviation from theory in the practical results.

The results are much more closely related to acoustical science, which treats of the disturbances in a gaseous, liquid or solid medium, travelling in all directions; for instance, a bell or whistle powerful enough, could not when sounded have its disturbing effects impeded by the curvature of the earth; the surrounding atmospheric air would transmit the disturbance round the corner, as it were. Therefore, I am driven to the conclusion that the disturbance set up by Marconi's apparatus is not propagated rectilinearly, like light, but is an electrical disturbance of the earth's electrical atmosphere, and that, if powerful enough disturbances are set up, they can be detected anywhere on the globe.

A writer in the *Electrical Review*, of New York, seems to have had the same idea, and perhaps others may. At any rate, it is quite as plausible as the rectilinear radiation light-wave theory, and better fits the facts as found by actual tests on the globe. Experiments on a small scale are difficult, but they are all resulting in confirmation of the transmission of electrical disturbances through the earth's surrounding electrical charge, or polarised atmosphere.

CORRESPONDENCE.

The Earthing Question.

Your article last week on the question of the earth return induces me once more to take up my pen to deal with this question.

Papers have been read from time to time, no doubt of great importance, on the improvements in dynamos, cables, and every other matter connected with electric lighting and power transmission, but the most important question as far as the public is concerned, viz., that of the electric wiring of their houses on the safest, and at the same time, the cheapest system, seems to have been utterly neglected.

The tendency of the present practice appears to me to be directed on wrong lines, both as regards safety and cheapness, and also the principles upon which these desiderata depend are entirely overlooked and misunderstood.

When many years ago I first brought out my patent system of adopting the continuous metallic return, the idea was looked upon with horror by many engineers.

Even the idea of having the two wires insulated inside a metallic covering was looked upon as most dangerous. In the course of time, perhaps, no doubt, due to the appreciation of the fact that if the two wires could be put through metallic fittings, there would be no harm in introducing the same wires through metal tubes, and the idea of a metallic covering was gradually accepted; but the important principle of having this metallic covering absolutely continuous and intact was altogether overlooked.

As regards safety, I defy contradiction when I state that if the wires are thoroughly and continuously protected by a metallic covering throughout, the same outer covering being earthed, it is practically impossible for overheating or fire to be caused.

In practice, however, what do we find—viz., that the tubing or metallic covering, instead of being intact, is put in in the form of what is known as a "split," admitting to the wires the corrosive alkaline action of the lime or cement, &c., in which it is embedded.

Even in cases where the whole of the wiring of the house is done with tubing it is often not thoroughly earthed, nor can the joints in the said tubing be considered as electrically complete.

In many cases the wiring by metallic covering is only partially carried out; and, in my opinion, this constitutes the greatest danger, for if from any cause the insulation of the wire gives way, the metallic covering at once becomes electrically charged; and if in contact with damp wood the result is that charring, if not a worse effect, is produced.

Cases of fire produced from this cause have come under my own special knowledge; and cases where the wiring has "perished" through the use of the open tube above referred to, has more than once been reported in your paper. In one particular case the whole of a large installation had to be entirely re-wired on account of trouble arising from this cause.

Further, with regard to the question of the earthed or bare return, the adoption of this principle, in my opinion, is the only one by which both safety and cheapness can be combined. In your article you state that engineers do not seem willing to grasp the nettle firmly. I can only say that I grasped the nettle firmly long years ago, and that it has not yet stung me. On the contrary, I have used this method of wiring with the metallic covering and bare return for eight years; and in every case with complete success. All the private installations which I have carried out are wired by this method, in addition to which, in a small town of some 6,000 lamps, this system has also been introduced; and I think I may claim that if there had been any sting in the nettle it would have been felt before now.

In addition to my own practical experience, I have never yet seen put forward by any electrical engineer with whom I have discussed the matter any really *sound* objections to the adoption of the earthed system. The supposed bogies of condensation and electrolysis are, as are most bogies, entirely imaginary, and absolutely do not exist in practice. The proof of the pudding is in the eating.

Sirs, I am doubtful whether, after all these years, any good can follow your invitation to discuss this subject in your or any other electrical paper, but if the question of the safest and most inexpensive method of wiring were taken up seriously by, say, the Institution of Electrical Engineers, or by a committee of engineers appointed for the purpose, I should only be too happy to lay before them my experience of the advantage and success to be gained by the adoption of the earthed system of wiring.

R. Frederick Yorke.

Stirling, *August 11th*, 1902.

In your issue of last Friday, you invite discussion on this subject, so that perhaps a few remarks may not be amiss, from the station engineer's point of view.

Your correspondent, "F. B.," in his diagram No. 2 (your issue of 18th ult.), appears to understand Mr. Proctor's proposal to be to establish intentional earth connections *both* at the generating station *and* on the distributing system; but this is obviously impracticable unless extremely heavy neutral factors be laid between the station and the distributors, which would defeat your editorial suggestions of the 18th inst., in the way of cheapening the supply.

I will not, therefore, discuss this further, but will turn to what I understand Mr. Proctor's own suggestion to be, viz., to make an intentional "earth" over part or whole of the distributing system only.

The position I wish to defend is that the connection with earth must be under control, and that, too, through a reasonable and constant resistance. Most station engineers working with the three-wire system will, I feel pretty sure, prefer that the earthing be at the station; but if the toleration of an *outside* earth connection is to meet with any favour whatever at their hands, it must be one that is under control and of constant amount.

Lack of time prevents my going more fully into these reasons now, but they are based on experience.

The question I put to you, Sir, is, then, the following:—If it were granted that an outside, properly-controlled, constant "earth" (with all its inconveniences to the station's working) might be tolerated on the distributing system, would it help matters as regards your proposed employment of concentric or other forms of cheap wiring?

I doubt it; because, if the area covered by the distributors be at all large, it will be necessary to put so much additional copper in the neutral distributors (to avoid the troubles of so many partial "earths" in the distributing system) as will probably quite compensate, or more than compensate, for the saving in house wiring.

Again, it would be necessary for the station engineer to insist on a minimum insulation resistance even on the "outer" of the concentric system of wiring, as otherwise the controlled "earth" on the distributing system would be

a farce, it being entirely swamped by the number of partial "earths" in parallel with it, and out of control.

The gain, then, to the wiring people will only be slight, and will be more than counterbalanced by the increased expense of heavier neutral distributors.

My next point against your proposal to use an "uninsulated outer" concentric wiring largely, is that if such a system could be tolerated, it plunges the station engineer hopelessly in the dark as regards the conditions of his feeder and mains. At present it is possible, by having a reasonable resistance (say, 2·2 ohms) between the neutral and the station-controlled "earth" connection, to measure the approximate state of insulation of the mains and feeders; but if we introduce an uncontrollable *dead* "earth" in the distributing system, there is no known method of readily measuring the insulation resistance of the "outers" of the three-wire system; nor, in my humble opinion, is it possible to devise such a method. I say this advisedly, having given some attention to this point.

Apart from this, a greater leak on one side of the system than on the other would mean a perpetual and uncontrollable loss of current, as Mr. Alex. Russell has shown us.

Such loss of current might be quite serious.

On reasons of safety, again, I should like to urge the impracticability of your proposal. Perhaps on a future occasion I may be able to say a word or two about this aspect of the case.

Unearthed.

[We have received a letter from a correspondent who signs himself "P.D.," but who omits his name and address.—EDS. ELEC. REV.]

The Standards in Ewing's Hysteresis Tester.

In the testing of iron or steel stampings for hysteresis by means of my hysteresis tester, the hysteresis of the sample is found by comparison with two or more standards whose hysteresis is known. Experiments which have recently been made here, lead me to doubt whether in all cases the standards maintain their quality so well as I have hitherto supposed, and it now appears desirable that users of the instrument should see that the values of the hysteresis which they assume in their standards are checked from time to time. If this precaution is taken, the apparatus may be relied upon to give consistent and accurate results.

I would advise users of the instrument, if they have not recently had their standards re-tested, to do so.

J. A. Ewing.

Engineering Laboratory, Cambridge,
August 11th, 1902.

The Salary Scandal.

Kindly permit me to point out that the pathetic wail of your correspondent "Esperan" is no isolated voice crying in the wilderness. It is all understood by hundreds of qualified electrical engineers, who, too, have had laborious days and more laborious nights.

It is a question that has also perturbed the minds of electrical engineers in the United States for some years, but when I tell your readers that some 2,000 successful students leave the colleges and technical schools of that country every year, qualified in every detail, from the expert handling of the stoker's shovel to the commercial managing of station accounts, it will be self-evident that the remedy is yet below the horizon of a remote future.

It is a state of things accurately foreseen by Herbert Spencer when he first expounded his doctrine of the survival of the fittest. It is an inexorable law made more inexorable still by society as at present constituted, as hopeless of repeal as would be the task of a man who had fooled himself into the belief that he could stem the torrent of Niagara with a salt spoon.

I do not say that the fittest always survive with regard to the "merely formal advertisement," for here the candidate might be the most unspeakable duffer, but fittest by virtue of his having a unanimous vote of the Electricity Committee already cut and dried when the respective merits of the hundred-and-one applications are adjudicated upon.

And the irony of it all! To think that, after our laborious days and midnight oil to fit us for scientific pursuits, our merits will sooner or later (in order to achieve the just reward of our toils whilst other men slept or drank or joined in the chorus of the latest comic song extolling laziness and the virtue of luck) have to be sorted out by the tinkers and tailors, pork butchers and pawnbrokers, confectioners and cats' meat dealers—all commendable occupations in their way, but entirely foreign to electrical engineering.

In conclusion, let me say what a poor commentary it is upon the Prince of Wales's exhortation to "Wake up!" when those who are already awake—and their name is legion—can at the best only hope for prices like the one advertised by Tonbridge.

Arc.

South Shields Electricity Accounts.

I notice in your last issue an extract of the article which appeared in the *Local Government Chronicle* commenting on the electrical undertaking of the South Shields Corporation, and I would point out to you that the statement made therein regarding the accounts being unsatisfactory and misleading, also that the expenditure incurred and paid out of the rates was suppressed, is, to say the very least, incorrect.

Year after year, since the commencement of the undertaking, all contributions from the rates and all deficits have been clearly shown in the published accounts of the borough, these deficits and calls from the rates being only too obvious to those interested in the undertaking.

I herewith send you copy of the last issued abstract of accounts. If you will refer to the abstract you will at once see the deficits and contributions from the rates since the commencement of the undertaking, and thus confirm my remark that the statement of the author of the article which appeared in the *Local Government Chronicle* is absolutely false.

I may say a copy of the said article appeared in the *Shields Gazette*, and at the Council meeting, held on the 6th inst., the article was most strongly censured: the same being an insult to those officials who, during the different periods in question, had compiled and audited the Borough accounts.

Regarding the remarks of the author of the article referred to, *re* depreciation, it would be absurd to give his statement a moment's consideration. Trusting to see the due publication of this disclaimer,

J. H. Cawthra,
Chief Engineer.

Borough Electrical Engineer's Office,
Holborn, South Shields.
August 9th, 1902.

[The statement of accounts appears to be clear enough, the amount contributed from the rates being plainly set forth. But there is no allowance for depreciation.—EDS. ELEC. REV.]

CURRENT SPECIFICATIONS.

CIII.—ELECTRICAL EQUIPMENT OF SECTIONS OF NORTH-EASTERN RAILWAY.

SUMMARY.

Extent of Contract.—Two specifications have been issued, one No. $\frac{33.3}{34}$ asking for high-pressure cable and sub-station equipment, the other, numbered No. $\frac{36.6}{13}$, requiring electrical equipment of coaches and permanent way.

Lines to be Electrically Equipped.—(*a*) Newcastle Central Station, *viâ* Wallsend, Percy Main, Tynemouth, Whitley Bay and Gosforth to Newcastle Central, a distance of 20 miles 1,676 yards; (*b*) Newcastle Central Station to Percy Main station *viâ* Heaton, Byker, St. Peter's, Walker, Carville to Percy Main, a distance of eight miles; (*c*) Heaton to Benton, a distance of 2 miles 1,670 yards; (*d*) Gosforth to Ponteland, a distance of 6 miles 1,628 yards; (*e*) Quayside goods line for goods traffic only, a distance of 1,210 yards.

Total Length.—About two miles of four-line track, four miles of single-track, and 35 miles of double-track. About 80 cross-over roads are also to be provided for.

Number of Coaches.—The necessary equipment for 50 motor coaches and 36 trailer coaches is also to be provided.

Number of Locomotives.—Two electrical locomotives are to be supplied for use on the Quayside goods traffic branch line.

Supply of Power.—Power will be purchased by the Railway Company from the Newcastle-upon-Tyne Electric Supply Company, who will deliver it as high pressure three-phase current at 40 cycles per second, 6,000 volts, at sub-stations in positions to be agreed upon.

Type of Transforming Apparatus.—May be either motor-generators or transformers working in conjunction with rotary converters.

Site of Company's Power House.—The energy will be generated at the new power house of the Newcastle-on-Tyne Electric Supply Company at Riverside, supplemented, if necessary, from the existing Neptune Bank power house. All high pressure cables supplied under this specification to connect with Riverside power house.

Type of High Pressure Cables.—To be suitable for use on 6,000-volt circuits, lead-covered, laid solid in bitumen or similar compound contained in earthenware troughs.

Pressure Test for Cables.—Three times working pressure at factory, twice working pressure after being laid and jointed.

Type of High Pressure Switchgear.—To be of oil-break type, no exposed high pressure parts being allowed on front of board.

Permissible Temperature Rise.—All transforming apparatus, when running continuously, to maintain temperature as measured by thermometer within 40° C. (72° F.) of atmosphere. To carry 25 per cent. overload for one hour without undue rise of temperature.

Working Voltage.—Any voltage approved by Board of Trade up to 650 volts direct current, as preferred by contractor.

Method of Collecting Current.—A third rail must be laid alongside the existing track to carry energy to the trains. It is open to contractors to employ the rails for the return current if they so desire.

Type of Train.—Each train will consist of three coaches:—One motor coach to seat 60 passengers. One trailer centre coach to seat 64 passengers. One motor coach to seat 80 passengers—a total of 204 passengers per train.

Approximate Weight of Train.—Sixty tons fully loaded, but without electrical equipment.

Average Speed Required.—Twenty-two miles per hour, including 20-second stops at stations.

Ultimate Service of Trains.—Forty-seven trains distributed at different points *en route*.

Type of Equipment.—Each motor coach of the passenger trains to be equipped with two motors, and to be operated on the multiple control system.

Rated Load of Motors.—To be the maximum load which can be carried by motor for one hour continuously without temperature rising more than 75° C. (135° F.) above surrounding atmosphere.

Coaches.—The coaches will be constructed by the railway company, who will also supply the trucks for the trailer coaches.

Guarantee.—The contractor shall state what number of B.O.T. units will be required by a train travelling the 20 miles 1,676 yards round trip *vid* Tynemouth in 60 minutes with 20-second stops at stations.

Weight of Goods Trains.—The weight of the trains to be drawn up the Quayside Branch incline will be 150 tons.

Frequency of Service on Quayside Branch.—Six trains per hour.

Capacity of Goods Locomotives.—Two locomotives are to be provided capable of starting with a fully-loaded train on an incline of 1 in 27.

Time of Completion.—The whole of the work to be completed within 12 months from date of acceptance of tender.

Penalty for Late Completion.—One per cent. of contract price for either section for each week late.

Specified Terms of Payment.—Up to 80 per cent. of value of contract work as completed, 10 per cent. on acceptance by engineers, and 10 per cent. 12 months later.

Specified Term of Maintenance.—Twelve months from date of completion for either section.

Stipulation as to Wages to be Paid to Workmen.—None.

Stipulation as to Conditions of Labour.—None.

Arbitration Proposals.—Limited, see comments.

Date for Sending in Tenders.—October 7th, 1902.

These specifications have been prepared by Mr. Charles H. Merz' who has been chosen by the North-Eastern Railway Company to act as engineer for the purpose of this contract.

In many respects these specifications are of great interest. Hitherto in this country the battle as to the best system of locomotion to adopt for suburban railway work has been mainly fought underground. With the exception of the Liverpool Overhead Line, a special undertaking, it has been in connection with London Tube Railways, the well-known and much-abused London Underground lines, and the Mersey Tunnel Railway that the victories of electric traction have been won. During the past year or two there have been many complaints at the meetings of the great railway companies and in Parliamentary Committee rooms as to the disastrous effect upon local railway receipts of the competition of the various networks of electric tramways which have been completed and set to work. The approaching completion of the Tyneside Light Railways, which will electrically connect several of the Tyneside towns by private routes, permitting of the employment of comparatively high speeds for the trams, has roused the North-Eastern Railway into action. Acting up to its high reputation for progress, it is the first of the great railways to boldly meet competition by adopting electrical traction over a considerable portion of its lines. On about 40 miles of track the passenger traffic will, in future, be by means of electrically-propelled trains, and we shall have the opportunity of examining the effect, upon ordinary railway working, of the substitution of electric for steam locomotives. That both railway and tramway companies should purchase their energy from the same company, and that in all probability it will in part be transmitted along the same mains, is only one of the amusing features of a particularly interesting situation, the full meaning of which can only be fully appreciated by those versed in the intricacies of local conditions.

We have, however, only congratulations for the Newcastle-on-Tyne Electric Supply Company in securing such a valuable customer, and can assure them that the character of their load factor, no less than their total output, will soon be the envy of nearly every other similar undertaking in the country. The railway company, in adopting electric traction, have appreciated the need for a faster service. The mean speed specified to be attained is 22 miles per hour, including an allowance for stops at every station of 20 seconds duration, or, taking the average longer stops at the principal stations, a schedule time of one hour for the entire journey round the Tynemouth loop, a distance of nearly 21 miles. This will be an improvement of from 10 to 12 minutes upon the present scheduled time for practically the same journey. The specifications for the work to be done are, in many respects, very incomplete. So much is left to the discretion of the tenderer that it will be extremely difficult to make any comparison of the offers received.

No attempt has been made to give the slightest hint as to the power which will be required on the line, and the location, as well as the size of the sub-stations is, in many cases, left entirely for the tenderer to decide. Under these circumstances, it is impossible for anyone to send in a full tender for the high tension cable and sub-station equipment section unless they work in conjunction with some firm who are tendering for the electrical equipment of the coaches and permanent way, and so obtain information as to the number, size, and location of the sub-stations.

We much regret that such an important specification should have been issued in this manner. While it should have been left open to tenderers to make any alternative proposals they desired, it was certainly, in our opinion, the duty of the consulting engineer to lay down such conditions as to size and location of sub-stations, normal output of motors required for the motor coaches and electric locomotives, the approximate size of the transforming units at the various sub-stations, and the current transmitting arrangements, that the main offers of each tenderer would be made on the same basis and would be directly comparable with each other. If by any variation from the engineer's wishes, any economy, either in capital outlay or improvement in working costs could be effected, these could still have been brought under the notice of the railway company as an alternative for consideration before arriving at a final decision.

While in one respect the specifications are remarkable for the manner in which the consulting engineer has succeeded in effacing all trace of his own personality, another feature is extent of the information required, not alone from the successful contractor but from all tenderers. Thus in the section relating to the equipment of the coaches and permanent way no less than 40 heads are given upon which either full information or carefully-prepared drawings are required. In fact, the documents read more like examination papers than business specifications. We know that there are a number of firms of such eminence in this country that, given the essential conditions of a sketch of the profile of the line, the mean speed to be attained, together with the length of stops to be allowed, the weight of the trains and the frequency of the service, they could and would submit proposals and estimates of cost for the equipment of any section of a line; and the railway company in the present instance will doubtless receive a number of such complete and reliable proposals. These offers will, however, be expensive to prepare, and will be based, not upon specific lines of requirements laid down in the specification, but upon their own experience and technical knowledge, taking as the only guide the elementary conditions mentioned above.

We have on many occasions spoken strongly against the practice of consulting engineers in their specifications to binding down tenderers to details of construction, and exact outputs and types of machines that they are precluded from giving to their possible clients the advantage of standard types. We, however, are equally of opinion that the function of a consultant is so clearly to specify the ends to be accomplished, and the means by which they should be gained, that the main offers of all tenderers are based on the same lines and are directly comparable, the option being at the same time given to the tenderer to make, if he so wishes, alternative offers of his own proposals.

The general conditions are on the whole acceptable. Tenderers should note that the possible penalty for delay in completion may be serious, since it is 1 per cent. per week of the full contract sum for each section. The date of completion, period of maintenance and terms of payment are satisfactory, but attention should be given to the limited character of the arbitration clause. All questions as to delay or interpretation of drawings or specification may be referred to an independent arbitrator, but all other questions are to be decided by the engineer. We advise that an attempt be made to modify this on the lines laid down in the draft Model Conditions issued by the Institution of Electrical Engineers.

LEGAL.

LONDON ELECTRIC SUPPLY CORPORATION *v.* GREENBERG & LAKE.

IN the Westminster County Court on Thursday last week, his Honour Judge Woodfall had before him an important case affecting free wiring agreements. The plaintiffs sought to recover from Messrs. Greenberg & Lake two years' minimum rental of the use of electrical fittings at 105, Queen's Road, Peckham, S.E.

Mr. Harrison Ainsworth, who appeared for the plaintiffs, explained that his company had an agreement with the defendants to fit up, by the Free Wiring Company, an installation, and one of the

terms of the contract was that defendants should pay a minimum rental of 1d. per light for five years. That was to cover, or in some measure reduce, the cost of putting in the installation. Defendants' solicitor said their defence was that the company were asked to remove the fittings, and partly did so.—Mr. Ainsworth said that did not matter. There was the case of the London Electrical Supply Company *v.* Priddis, which laid down that so long as they had the right to use the fittings they must pay.—Mr. Lake deposed to the frequent failures of the light supplied by the plaintiffs, and in consequence of that gas was taken, for which the fittings cost them £60. The company was asked to take away the fittings, and took the arc lamps and subsequently the meter. Even had they wanted to do so they could not have used the supply without a meter, though the 60 lights were still there. Evidence on behalf of the company went to show that as the current was not used, the lamps, which were expensive, were taken away. The meter would not have been taken away unless they had been asked, but they could not speak positively.

His Honour, in an exhaustive judgment, found for the defendants with costs. The facts here were quite different from those which counsel had cited, where the defendants could have made use of the fittings, but here the defendants could not, as the meter was taken away. Besides, the contract was for the use of the fittings. Had the defendants had the use of them? The answer was that they had not. Plaintiffs, when told to remove the fittings, had declined, but not only did they take away the lamps, but the meter. He had nothing to do with the Wiring Company. Even when they took the meter away, they might have protected themselves, but they did not. He should, if necessary, have been prepared to find that the plaintiffs acquiesced in putting an end to the agreement, but he did not think that necessary. The claim says: "It is for the use of the installation." If defendants had not the use of the installation, it was neither law nor common sense that they should be asked to pay for it. The judges, in deciding the case of Priddis, did not mean to say that they must pay if the installation was defective. Plaintiffs could appeal if they liked.

National Electric Wiring Company, Limited, *v.* Davis.

Judge Addison, K.C., sitting at Greenwich County Court on August 1st, had before him a case in which the National Electric Wiring Company, Limited, sued T. M. Davis, a chemist, of 241, Lewisham High Road, for £25 15s. damages for alleged wrongful conversion of an electric light installation fitted by the plaintiffs in the premises now occupied by the defendant. It appeared that the plaintiffs agreed with a previous tenant of the premises to fit up the installation on the free wiring system, the tenant to have the right to purchase after a stipulated period. Defendant's predecessor, owing rent, left behind certain fixtures, and these became the possession of the defendant by agreement with the landlord, who had no knowledge of the agreement of the plaintiffs with the previous tenant. On being informed of the agreement, defendant claimed the installation, but informed the plaintiffs that they could take it away, as he had an estimate from an electrical engineer to put in an installation for £6. The plaintiffs continued to supply the current, and the defendant, hearing nothing further of the matter, concluded that they had dropped their claim.

Judgment was entered for the defendant.

Sandown Gas Company *v.* Sandown Electric Light Company.

The Sandown Electric Light Company is the defendant in an action instituted by the Sandown Gas Company, which seeks to recover £22 18s. 4d., the value of 110,000 cubic feet of gas alleged to have escaped from a service pipe through a fracture caused by a pickaxe used by the Electric Light Company's workmen.

At the Isle of Wight County Court on August 6th, Mr. Wilton, on behalf of the electric light company, asked Judge Gye whether the case might not go to arbitration, as provided in the Act.

Mr. Marsh, for the gas company, contended that the Act did not apply in this case.

The Judge upheld this contention, and said that the case must be tried in the County Court.

BUSINESS NOTES.

Catalogues and Lists.—Messrs. Wallach Bros. have sent us a price list containing descriptive details of their "Star" patent whitewashing machine, a very convenient device for the whitewashing of factories, as required under the new Act.

Messrs. J. B. Guthrie & Son, of Leadenhall Street, E.C., who are the sole agents for Smith's Injector Co., Ltd., of Nottingham, have sent us an illustrated list of their patent steam cocks and valves.

Correction.—In our final instalment of the Tramway Exhibition notices we stated that the "Protected" rail bonds, &c., formed "the leading lines of Messrs. Back & Manson (the Forest City Electric Company)." This was, of course, an error, Messrs. Back & Manson's being another exhibit altogether. The "Protected" bonds were shown by the Forest City Company at their own stand, together with the other specialities mentioned in our note.

Electrical Wares Exported.

Week ending Aug. 13th, 1901.		Week ending Aug. 12th, 1902.	
Aden. Teleg. cable	Value £15,190	Alexandria	Value £44
Alexandria. Teleg. mat.	414	Amsterdam	205
" Teleg. wire	40	Auckland	720
Amsterdam	209	Bombay	76
Bangkok	43	Brisbane	2,268
Bombay	14	Calcutta	124
Brisbane. Teleg. wire	51	" Teleph. mat.	68
Calcutta	858	Channel Islands	77
" Teleg. wire	117	Chefoo. Teleg. apparatus	44
Cape Town	1,268	Christiania	719
" Teleg. mat.	875	" Teleg. wire	74
Colombo	48	Durban	60
Copenhagen	2,357	East London	79
" Teleg. wire	1,482	Fouchou	25
Durban	964	Gibraltar	185
East London	10	Melbourne	671
Fremantle	370	New York	129
Gibraltar	19	Ostend	10
Gothenburg	82	Perth	42
" Teleph. cable	93	Rio de Janeiro. Teleg. mat.	500
Hamburg. Teleg. mat.	20	Rotterdam. Teleg. mat.	50
Hong Kong	91	Sekondi	25
Launceston	341	Shanghai	265
Madras	755	Sydney	809
Malta. Teleg. mat.	500	Wellington	131
Melbourne. Teleg. wire	375		
Ostend	45		
Otago	82		
Penang. Teleg. mat.	63		
Perth	348		
Port Elizabeth	41		
Rio Janeiro. Teleg. mat.	6,734		
Rotterdam. Teleg. wire	53		
Shanghai	14		
Singapore	37		
Stockholm. Teleg. wire	97		
Sydney	2,538		
Tientsin. Teleg. mat.	654		
Wellington	25		
" Teleg. mat.	506		
Yokohama	239		
Total	£37,542	Total	£6,725

Foreign Goods Transhipped.

Antwerp. Elect. apparatus	Value £400	Gothenburg. Elec. appar.	Value £17
Ghent. Elec. apparatus	60	Melbourne. Elec. apparatus	53
Gothenburg. Elec. apparatus	40	Sydney. Elec. fittings	65
Total	£500	Total	£135

Coronation Decorations.—The Acorn Hotel, Birmingham, was effectively lighted up on 9th inst. The scheme adopted is effective both by day and night; festoons of artificial flowers are carried across the front of the building, the lamps being fitted with Taylor & Co.'s micalorite reflectors, with the exception of the centre "E. R.," in which prismatic reflectors of polished metal are used with excellent results. The whole reflects credit on the consulting engineer, Mr. E. H. Johnson, A.I.E.E., and on the management as represented by Mr. Wilkinson, who has maintained the natural flower decorations in red, white, and blue from the original date fixed until now.

Dissolutions and Liquidations.—The Davy Electrical Construction Company is winding up voluntarily, with Mr. G. Frampton, 37, Casselden Road, Harlesden, N.W., as liquidator.

The Direct Telephone Exchange Syndicate meets at 52, Leadenhall Street, E.C. (Hof & Co.), on September 12th, to hear an account of the winding up from the liquidator, Mr. T. F. Smith.

Electric Launch.—Sir Whittaker Ellis has presented a large and handsome electric launch, the *Raymead*, to the Prince of Wales.

Germany.—New works for the manufacture of calcium carbide are about to be erected at Brandenburg, the contract for the electrical equipment having been secured by the Allgemeine Elektricitäts Gesellschaft, of Berlin. Water-power is being utilised.

Körting Gas Engines.—Messrs. Mather & Platt, Limited, of Manchester, have decided to manufacture at their works gas engines of the Körting double-acting two-cycle type of 400 B.H.P. and upwards, more especially for driving dynamos. As they are constructors of the latter, they are in the advantageous position of being able to build the complete combined plants in their own workshops. It is stated that the largest power developed in one cylinder of any gas engine hitherto manufactured in this country has been about 300 B.H.P., but Messrs. Mather & Platt are prepared to offer engines developing 400, 500, 600, 700, and 1,000 B.H.P. in one cylinder, or double these powers in two cylinders, and can construct these engines to work with blast furnace gas, Mond or other producer gas, or town's gas. We understand that the number of engines of the "Körting" type hitherto constructed or now on order represents nearly 45,000 B.H.P. Single cylinder engines of 700 and 500 B.H.P. are now running at Düsseldorf Exhibition, and can be inspected there, and the firm are at the present time building one each 700-H.P. and 500-H.P. engines in their works at Manchester.

Manchester and District Association of Electric Lighting and Power Contractors.—A general meeting of this association was held on July 31st at the Tweedale Restaurant, Market Place, Manchester. After a few introductory remarks from the chairman, Mr. J. Dugdill, the secretary presented an account of the work of the association. Reports of the northern section meetings at Liverpool and Sheffield were read, and also the report of a deputation to the Manchester Corporation engineer, Mr. G. F.

Metzger, regarding revision of the wiring regulations. The points raised with Mr. Metzger were all agreed to by him, and the deputation recorded their thanks for the courteous manner in which he received them. Several points of importance were raised, including the sanctioning of the use of fibre-insulated cables under certain conditions. The question of workmen's cards and a register of workmen was brought forward, and a sample card submitted which it is proposed to adopt throughout the northern section. It is expected that this will be ready for issue shortly. Three new members were proposed and accepted, and there was a short discussion on general subjects.

Silver Medal.—The Glacier Anti-Friction Metal Company, Limited, has been awarded a silver medal for its collection of Glacier Anti-Friction Metal at the Exposition de Lille. This was the highest award given for anti-friction metals.

The Canadian Arch.—The Canadian Arch, on the nights of the 9th, 10th, and 11th insts. was again lit up with Nernst lamps. The Electrical Company, Limited, 122—124, Charing Cross Road, W.C., on this occasion used for the purpose 600 Nernst lamps of the 1-ampere size, and the result once more was great success.

The "Giovenale" Pressure Indicator.—The apparatus illustrated herewith is intended for use in connection with high-pressure installations, where it is necessary to be able to see at a glance the condition of the circuit. It consists of a wire of plated brass, bent and welded, as shown in fig. 1. In the middle of the ring formed at one end is a disc of aluminium, mounted in such a way that it is free to rotate. A slight increase of weight is given to one-half of the disc, so as to keep it in a vertical position within the ring in which it is carried. When a charge of electricity is given to the apparatus, the movable portion tends to move away from the fixed part. The long leg of the device enables the instrument to be applied directly to any desired apparatus, by fastening it on terminals, or suspending it freely. Its use is claimed to be particularly advantageous in transformer stations. The high-pressure fuses, which are customarily placed in front of the transformers, are usually fixed in insulating boxes of porcelain, fibre, or other material. On noting a shortage of energy in a transformer station, the transformer is examined, but it is not apparent whether the loss is taking place in the conductor, the fuses, or in the transformer itself. By fixing the "Giovenale" indicators on the ends of each

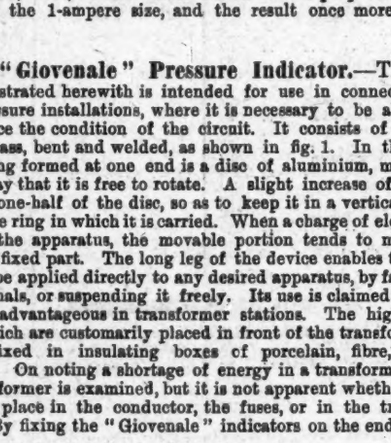


Fig. 2. Fig. 1.

The figures show the indicator as it appears when charged.

"Giovenale" Pressure Indicator.

fuse, the point at which the leakage is taking place will be clearly seen. Referring to fig. 2, if the disc at A does not move, it is a sign that the conductor is not charged. If A moves, while B remains stationary, it is clear that the fuse has gone. If both A and B move, the leakage must then be sought for in the transformer. In a polyphase plant it is easy to determine the fuse that has gone. When one fuse, say A, has gone, and the other remains in order, the electric condition is still maintained in B, because the latter is in contact with primary wires joined together at the neutral point, the fuse of which remains intact. The potential, however, is much lower than that in A, and therefore the disc in the indicator B moves much less than that of A, thus clearly indicating which is the faulty fuse. It will be understood from the foregoing that the sensitiveness of these indicators should be commensurate with the pressure of the plant in connection with which they are to be used. They can easily be made for plants of 200 volts pressure and upwards, and, if necessary, the sensitiveness may be increased in various ways and the indicators thus adapted to lower pressures.—*L'Elettricita.*

Trade Announcements.—Messrs. T. Bolton & Sons, Limited, of Broad Street Metal Works, Birmingham, have acquired the business of copper smelters and metal manufacturers which has been carried on for many years by Messrs. Thomas Bolton & Sons, at Oakamoor, Widnes and Birmingham, and under the style of Newton, Keates & Bolton, at St. Helens. The plant having been recently extended and improved, and the management being continued and strengthened, they are in a position to guarantee rapid execution of all contracts, while fully maintaining or even improving upon the standard of excellence of manufacture of the late firm.

What our Consuls Say.—*Java.*—Consul Davids reports that a long-distance telephone service was instituted last year between the various ports in Java, and, he states, it is proving a great boon to merchants.

South Italy.—In a supplementary report on the trade of South Italy for the year 1901, Consul Neville-Rolfe (Naples) states that horse tramcars have become a thing of the past in his consular district, all cars being now driven by electricity. The increase in the speed of transit is much greater in the Naples district than in towns built on the level, because the electric cars travel up-hill as fast as on the flat, whereas the horse cars had to go at a foot's pace, in some cases for miles together. Besides the increase in accommodation and pace, many more cars have been put on and several new lines opened. To give an example, the line leading to the fashionable suburb of Posillipo gives the public exactly eight times the accommodation it gave last year with horse traction. The telephone system has also been much improved and extended. There is no limit to the number of messages which may be sent at any time of the day or night at £8 per year on a three years' agreement. The electric lighting is making great progress. It is hoped very shortly to cheapen the cost of generation by utilising the waterfall of Piedimonte d'Alife, some 30 miles off. In the meantime the cables are being extended to the suburbs.

Port Said and Suez.—Reporting on the trade and commerce of Port Said and Suez for the year 1901, Consul Cameron states that the percentage of ships using the electric light for navigation by night was 93·7 per cent. as against 91·2 per cent. in 1900. Mr. Cameron also reports that a limited liability company is about to be formed in order to take over and work a concession granted by the Egyptian Government for supplying electric light to Suez and Port Tewfik for 20 years, and also to erect ice machinery and cold storage rooms. In regard to electric lighting, Mr. Cameron thinks there is every probability that the objects of the company will receive the general support of the public.

Marseilles.—Consul-General Gurney, reporting on the consular district of Marseilles for the year 1901, refers to electricity and water-power and its effect on "the threatened American coal invasion," which has been postponed "till a more convenient season," and he remarks that Americans have had an eye on the water-power of the Maritime Alps. The attempt, however, to get control of the water-power of this district has not been successful. He goes on to say that the Americans found a French company already in the field, being organised with a view to securing all the water-power available in the Alpes Maritimes from Marseilles to Mentone. The object of the proposed company is to supply electric light and also electric power to all the towns on the south-eastern coast of France. It is also hoped to supply power to the electric locomotives which the director of the Paris—Lyon—Méditerranée Railway Company proposes to test on the Cannes to Monaco section of the line during the winter season. It is said that Mr. Noblemaire, director of the Paris—Lyon—Méditerranée Company, has made it a personal matter to start electric traction on the Mediterranean Coast line before his retirement from the directorship of that company.

Prague.—Consul Wentworth Forbes, in his report on the trade of Bohemia for the year 1901, states that Prague is as well provided with electric trams as any city in Europe, and accidents from falling telephone and telegraph wires are extremely rare. To his report he attaches a description of an invention by an electrical engineer of Prague for protection against such accidents, which he thinks may be of some use to lines using the overhead trolley system in the United Kingdom. The number of persons using the electric trams of Prague were 24,344,047 in 1901, as against 20,160,573 in the previous year. The receipts in 1901 were £107,479. Among the improvements made at Marienbad since last season is an electric tram which now runs from the railway station to the town, opened in May this year. He states that the charge for telephone installation in Prague is £4 5s. 3d. for any distance from the Central Exchange up to 500 metres, and for every additional 100 metres or fraction thereof, 16s. 8d. The rental of the apparatus is £2 10s. per annum. The connecting service fee is £1 13s. 4d. per annum. For the use of public telephones, a charge of 2d. is made for a period of three minutes after connection has been established. The length of the lines was 68,885 English miles. The Government is about to spend a sum of £833,000 for the extension of the telephone system in Austria. There are 200 new telephonic connections projected in the different parts of the Empire, in Bohemia alone about 50 new lines. It is proposed to raise a loan for the purpose of defraying the cost. Last year the firm of Kolben & Co., of Prague, sold machinery to the value of £70,834, as against £117,125 in 1900. Students from the Prague Technical School recently visited the works, and were shown three giant dynamos of 5,000 H.P. nearing completion, which had been ordered for one of the London central stations, also a 1,000 H.P.

machine for the town of Newport, for its electric trams, as well as a uniform group, each of 250 H.P., for the city of Dublin.

Gambia.—According to the annual report on the Colony of Gambia (West Africa) for the year 1901, no inland telegraph service exists in the colony. There is direct telegraphic communication with Europe, *vid* St. Vincent, and also with the other West African Colonies. During last year telephones were introduced into Bathurst on a small scale—Government House, the Colonial Secretary's office, and the Treasury being placed in communication. The distance covered is about a mile. It is proposed to extend the system to other Government offices at an early date.

St. Petersburg.—Consul-General J. Michell reports that the electric fittings and installation business is mostly in German hands, competition being rendered difficult in this branch of industry by the low prices of the Germans; but the Russian consumer is said to be arriving at the conclusion that the cheap German article is of but little value, and costs more in the main, than more expensive fittings. It is considered, says Mr. Michell, that the trade in this branch has a good future, and British manufacturers should spare no effort to prove to the Russian purchaser the superiority of their productions in this particular industry. Phonographs and gramaphones, Mr. Michell states, are growing in demand at St. Petersburg, and a good opportunity presents itself for establishing such instruments of British manufacture in the Russian market.

ELECTRIC LIGHT AND POWER NOTES.

Ashford (Kent).—The U.D.C. has decided to fully consider the question of laying down an electricity plant at the Gas Works, and to inform the Electrical Supply and Traction Company that if they persist in applying for a prov. order to supply the town, the Council, having its own order, will doubtless oppose them.

Auckland.—Electric coal-cutting machines are to be adopted at the Byers Green Colliery, Auckland, by Messrs. Bolckow, Vaughan & Co. This innovation will diminish the cost of production, and increase the output.

Bakewell.—At the meeting of the U.D.C., on Aug. 7th, a letter was read from the Nottingham and Derbyshire Electric Power Company (Limited), offering to assist the Council in obtaining a prov. order on terms to be mutually arranged. The Council decided to take no action in the matter.

Barnstaple.—The T.C. has resolved to borrow £21,600 for electric lighting purposes.

Barry.—At this great centre of dock and railway work it has been agreed by the U.D.C. to open negotiations with the South Wales Electrical Power Company for the transfer of their powers to supply electrical energy in the district, and also to obtain expert advice on the matter of terms.

Blackpool.—Shortly after 9 o'clock on Saturday evening the electric lighting of the town was suddenly cut off, both private and public lighting being entirely suspended, owing to a fire on the main switchboard at the electricity works. The plant operated through the switchboard was promptly shut down by the engineers in charge. Mr. Furness, the borough electrical and tramway engineer, was soon on the works, having noticed the sudden extinction in Church Street. The fire was quickly extinguished with buckets of sand, but not before considerable damage was done to the main cables and switchgear, and on examination it was found impossible to give a supply until repairs had been effected and new cable and fuses substituted. All members of the staff were on the works, having hastened there immediately on hearing of the stoppage of supply, and at once commenced the work of repairs, which were sufficiently advanced to allow of the current being switched on for lighting early on Sunday morning. Fortunately, the tramway switchboard was not damaged, and therefore no interruption took place in the tram service. Mr. Furness greatly commends the prompt action of the engineers in charge at the time, for had not the lighting plant been shut down immediately and a plentiful supply of sand used, the results would have been disastrous. The cause of the fire is attributed to one of the main high pressure feeder fuses arcing after the fuse had blown. The lighting board is of a very old type, one of the first of its kind, and is considered, in many of its details, obsolete as compared with the later types of switchgear now in use in many alternating current stations. The repairs effected to give a supply do not remove the danger which exists with this early type of board, and Mr. Furness will doubtless, at the earliest moment, submit a report to the Electricity and Tramways Committee as to the switchgear with a view to preventing a recurrence of Saturday's experience.

Brierley Hill.—The U.D.C. on Monday decided to ask the Midland Electric Power Company to quote terms for energy for public lighting.

Buenos Aires.—The *Review of the River Plate* says that the returns of the electric light companies in Buenos Aires for 1901 were as follows:—

	Subscribers.	Incand. lamps.	Arcs.	Total equivalent 16 C.P.
Primitiva	1,894	43,693	675	54,678
River Plate Electric Light and Traction	926	17,972	78	18,596
Cia. Alemana	3,787	120,252	1,040	131,127
Total, 1901	6,257	181,847	1,793	204,401

The output of the companies was, in units:—

	For light.	For power.	For traction.
Primitiva	1,657,906	818,770	—
R. P. E. L. and T.	850,574	33,347	—
Alemana	3,722,216	693,838	2,657,393
B. A. and Belgrano Tramway ..	—	—	3,661,472
La Capital	—	—	3,765,407
Total	6,230,096	1,045,955	10,084,272

—being a grand total of 17,360,223 units. The total output for 1900 was 9,078,112 units.

The steam engines in the City of Buenos Ayres on December 31st, 1901, numbered 875, with a total power of 28,900 H.P., and gas engines 236, with an output of 1,067 H.P.

The public lighting (electric) of the city was carried out as follows:—

	Units.
Primitiva de Gas	276,219
Cia. Alemana	916,622

The prices paid were: 15 amperes, $25.70, 10 amperes, $21 per month to the Primitiva, and to the Cia. Alemana $24.75 and $19.10.

Cape Town.—The Acting Mayor of the Municipality of Mowbray recently stated that the Electric Lighting Syndicate were busily engaged in putting down a new and improved plant.

Cardiff.—The Trustees of the Bute Estate have, it is understood, refused permission to lay down electric mains on their land, although a number of the tenants have applied for electric power and light, and Sir W. T. Lewis, Lord Bute's agent, is to be approached in the matter. The Corporation is also advised by the Electric Lighting Committee to apply for powers to carry on the selling or letting for hire of motors. Bristol is also taking steps in this direction; arc lamps are to be installed on the electric tramway routes, and it has been decided to put aside £500 as a reserve fund for this purpose.

Carnarvonshire.—On Mr. Assheton Smith applying for support in obtaining a prov. order to enable him to supply electricity to Port Dinorwic, Dinorwic Quarries and District, the County Council on August 7th decided to appoint a special committee to consider the advisability of the Council itself applying for the necessary powers.

Chadderton.—The Provincial Electric Supply and Traction Company intends to apply to the B. of T. for a prov. order to supply electricity within the district. The U.D.C. has decided to ask the company's terms. It was further resolved that a letter be sent to the Oldham Corporation stating that they were "threatened" by various companies who wanted to supply the district with electricity for both lighting and power, and asking them whether they would be prepared to supply the Council in bulk, and, if so, upon what terms.

This is a typical illustration of the spirit in which municipalities deal with companies. Themselves traders, both collectively and individually, they cannot bear to think of any but another municipality trading with their own. However, there will be a sharp awakening when the terms of the Oldham Corporation for electricity supply in bulk are laid side by side with those of a properly constituted power distribution company.

Clayton.—The undertakers of Rishton, Great Harwood, and Clayton-le-Moors Electric Lighting Order are unable to comply with Sec. 99 of the Order, and have asked the local authorities to take over the powers of the order and purchase the undertaking for the sum of £150.

Colchester.—The Electric Light and Power Committee has received from the L.G.B. their formal sanction to the borrowing of £8,057 for electric lighting extensions. The following additional staff is to be engaged, viz., a chief assistant, with a salary of £2 10s. per week; a shift engineer at £1 5s. per week; a second engine driver, at £1 15s. per week; and a trimmer, at 15s. per week.

Dartford.—The U.D.C. has decided to ask the L.G.B. to sanction loans amounting to £31,000 for electric light extensions and "free wiring," £3,000 being apportioned for the latter purpose.

Devizes.—A company to be formed is to apply for a prov. order to supply electricity in the district.

Dorchester.—A report on the lighting of the borough by electricity has been prepared by Messrs. J. and J. S. Enright, Westminster, S.W., who estimate that the capital expenditure on the installation would be in round figures £20,000. If steam plant is used for generating the current the total annual expenditure, including £1,200 interest and instalment of sinking fund on loan, is estimated at £2,547; but if gas plant is used, as the engineers recommend, a considerable saving can be made, and the total expenditure is estimated at only £2,214 a year.

Dublin.—The report of the Lighting Committee states that the work in connection with the new electric lighting scheme has made good progress during the past few months. The laying of the mains has been practically completed on the south side of the city, and is being rapidly pushed forward on the north side. Up to June 30th 134,000 yards of cables had been laid.

Eastbourne.—The Corporation on August 6th decided to reduce the prices for energy as under from October 1st:—Private lighting, 7½d. to 6½d. per unit; meter rents from 4s. to 2s. 6d. per quarter; public arc lighting from £30 to £25 per lamp. These prices are to be reconsidered at the end of 12 months. It was also decided to set aside out of the present profits of £5,078 9s. 7d., £2,000 as a depreciation and reserve fund.

East Cowes.—The Electric Light Company is competing with the Gas Company for public lighting, and has offered to convert the lamps and provide 25-C.P. lamps, with 50-C.P. lights at important corners, on a five years' contract, for £2 10s. per lamp per year. The Gas Company offers to provide new lanterns and fix incandescent burners for £2 15s. per lamp on a two years' contract, and £2 12s. on a five years' contract, the candle-power to be 60.

Electricity in Dockyards.—The Admiralty are considering a scheme, prepared by Sir William Preece, for the installation of electric light and power throughout Chatham Dockyard. A large power station will be erected, and it is proposed to replace all the smaller engines, including the cranes, haulabouts, and engines at the slips, docks, and workshops, by electric motors. A similar scheme is in contemplation for the Devonport yard.

Foot's Cray.—As the result of the recent action of the ratepayers, the U.D.C. has resolved to enter into an agreement with Bexley for the supply of electricity, unless better terms can be got from Woolwich.

Frome.—The U.D.C. has settled the terms of the agreement with Mr. Medhurst as consulting engineer to the Council for a period of five years at a commission of 5 per cent. on the original contract, and 3 per cent. on all extensions; certain terms prepared by Messrs. Edmundsons, Limited, upon which they were prepared to construct and afterwards carry on the electric supply works for a certain period, were considered. Application is to be made to the L.G.B. for sanction to borrow the sum of £20,000.

Goring.—The Goring and Streatley Electric Supply Company intends to apply to the B. of T. for a prov. order for the supply of electrical energy within the parishes of Goring and Streatley.

Grimsby.—From October 1st the Corporation will charge private consumers 4½d. per unit instead of 5d. for lighting, and 2½d. for power, instead of 2¾d. as at present.

Guiseley.—The Provincial Electric Supply and Traction Company intends to apply to the B. of T. for a prov. order to supply electricity within the district of the U.D.C.

Hebden Bridge.—The U.D.C. has received notice that the Provincial Electric Supply and Traction Company intends to apply to the B. of T. for a prov. order to supply the district with electricity. The Electricity Committee has considered the plans and estimates for the proposed electrical generating station, prepared by Mr. Emmott, the engineer, and has resolved to recommend them to the Council for adoption, and that application be made to the L.G.B. for sanction to borrow the necessary amount to carry out the work.

Hornsea.—The U.D.C. intends to confer with Edmundson's Corporation, and to ascertain on what terms they would be prepared to instal and carry on the electric lighting works.

Hosforth.—The Provincial Electric Supply and Traction Company intends making application to the B. of T. for a prov. order to supply electricity within the district.

Irvine.—The T.C. has agreed to commission Messrs. Kirkland & Capper to make a survey and report to the Council as to the installation of electrical plant by the Corporation for the lighting of the town.

Italy.—Arrangements are in progress for the utilisation of the hydraulic power of Mont Cenis. The installation is being carried out by the Thomson-Houston Mediterranean Company. The power available is estimated at 9,000 H.P., to be augmented to 12,000 H.P. in utilising the waters of Mont Cenis Lake. It is proposed to transport the energy to Turin, a distance of 60 kilometres. A start is to be made with 5,000 H.P. The station at present contains three units, each comprising a turbine of 1,600 H.P. at 50 revolutions per minute, and an alternator. The alternators have each a power of 1,400 KW. at a pressure of 3,000 volts. The pressure will be raised to 30,000 volts by means of transformers for transmission to Turin.

King's Norton.—The U.D.C. has decided to lease its powers under the Electric Lighting Order to a company.

Kingston-on-Thames.—In order to minimise the smoke nuisance and to provide for the further development of the electric lighting business, a new shaft has been erected at the Corporation works. The shaft is 150 ft. high from the flue level, and is built on a foundation of concrete 20 ft. deep and 30 ft. square. The inside diameter is 9 ft. 3 in. at the top. The contract was entrusted to Messrs. F. & E. Davey, of Southend-on-Sea, and the whole of the construction of the shaft has been carried out hand over hand from the inside, without scaffolding. Major Macaulay, borough surveyor, prepared the plans.

Liverpool.—The feature of Liverpool's illuminations in honour of the Coronation was an illuminated electric car, which justly won the admiration of Liverpool people on Saturday night last. 1,150 16-C.P. lamps were arranged on the car, whilst at the front and rear of the car were fixed huge revolving stars. The spectacle presented by the car was brilliant beyond description. The designs in which the lamps were arranged had been devised by Mr. C. R. Bellamy, the general manager of the Liverpool tramways.

London.—One of the cables of the Metropolitan Electric Supply Company became ignited in some way last Friday morning, and flames burst from the pavement in Wardour Street, Soho. A quantity of gas exploded, and blew out one of the Post-Office testing-boxes. The Great Marlborough Street firemen were soon on the spot, and put the flames out. On the same day an electric fire took place in a junction box belonging to the Poplar Borough Council.

DEPTFORD.—The B.C. has decided to oppose the application of the County of London and Brush Provincial Electric Lighting Company, for a prov. order to supply the borough, as the Council is considering the advisability of applying to the B. of T. for the necessary powers.

Luton.—Mr. W. H. Cooke, the resident engineer of the municipal electricity supply station at Luton, is organising an exhibition of motors and machinery suitable to the requirements of manufacturers and the local trades, to be held in the Plait Halls from October 6th to 12th next. The Corporation will extend the cables to the Exhibition buildings, and supply energy free of charge.

Melbourne.—Many complaints have been received by the City Council about the high charges for electric lighting from the municipal electricity works. It is explained that this is due largely to the fact that under the old system many consumers were charged below cost price. At a meeting of the Council on June 30th, says the *Melbourne Age*, Councillor Pleasance asked the Council to accept the tender of the Australian General Electric Company for the supply of 63,750 incandescent lamps at £2,418 9s. 9½d. That tender, he said, was the highest but one, of seven or eight received. In the past low-priced German lamps had been used, which did not give good light, and were not economical. That was the result of accepting low tenders. Last year a tender had been accepted for 24,000 lamps, and now the Committee were in serious trouble with the firm whose tender was accepted, because every one of those lamps had to be returned. That, in fact, was the cause of the complaints by the consumers. The lamps were to be supplied according to specification—of certain candle-power, economy of use, &c. The company had been called on to exchange the whole of the lamps supplied for others. Altogether, about 6,000 of the cheap lamps had gone into use, the remainder being still in store. By reason of the faulty lamps, the supply on hand had gone down tremendously, and, in view of the increase in the number of customers, required to be repleted. He felt sure that within a few months the cost to consumers would be brought down. The tender recommended was accepted.

Mold.—At a meeting of the U.D.C. last week an offer from the National Electric Wiring Company to report upon a scheme for lighting the town with electricity was accepted.

Newhaven.—At the meeting of the U.D.C. on July 30th, the Lighting Committee recommended that Mr. Warden-Stevens should be informed that the Council could not offer facilities for the supply of electricity in the district. Opposition was taken to this, and it was decided that the Council should ascertain what terms would be offered for the acquisition of the Council's powers.

Newport (Mon.).—The Electricity Committee has under consideration a recommendation of the consulting engineer, Mr. H. F. Parshall, to make additions to the plant as follows:—Steam generating plant, including two boilers, one 800-I.H.P. engine, one 500-KW. generator, additions to switchboard, &c., the estimated cost of which is £10,379 6s. 8d. Mr. Parshall further recommends that the portion of network now supplied from the Town Hall sub-station be detached, and that two sets of feeders be run from the new generating station to the Town Hall, and the distribution controlled from there; and that this work be treated as an extra to the present contract of Messrs. Henley's Telegraph Works Company, Limited, the price being £1,974 4s. 4d.

Okehampton.—Electricity is to be utilised for street lighting, owing to a dispute as to charges between the U.D.C. and the gas company.

Ossett.—The T.C. on Monday decided to engage an electrical engineer to report upon the proposed electric light installation for the town.

Pangbourne.—The Whitchurch and Pangbourne Electric Supply Company intends to apply for a prov. order for the supply of electrical energy within the parishes of Whitchurch and Pangbourne.

Railway Signals.—A novel issue has arisen at Newport, Mon. Two signal lamps had accidentally become extinguished in the busy railway area beyond the Gaer Tunnel, outside Newport, where the Alexandra Dock sidings meet and coalesce with the main line of the G.W.R. A youth was sent to re-light these shortly before midnight; he had to cross the main line, and was caught by a fast train and killed outright. The evidence showed that a similar fatality occurred at the same dangerous spot in February last, and the jury added a rider that in their opinion the railway company should substitute electricity for oil at these signals, the foreman pointing out that electricity was available, and that as the signals could be lighted and extinguished from a switchboard in a cabin or office a mile distant, there would be no recurrent danger to valuable young life. The company's representative present promised that the jury's rider should be forwarded to the proper quarter.

Rugby.—A L.G.B. inquiry into the U.D.C.'s application for a loan of £9,000 for electric lighting purposes was held last week.

Sandal.—The Provincial Electric Supply and Traction Company intends to apply to the B. of T. for a prov. order to supply electricity within the district.

Sleaford.—The U.D.C. has decided to extend the electric light mains in order to supply the extensive foundry erected at New Quarrington by Messrs. Hempstead & Co.

Southampton.—Owing to the three months' delay in obtaining powers from the L.G.B., and other unexpected difficulties, the borough electrical engineer reports to the T.C. that the new electricity works cannot be got to work in time for next winter's load. To meet the emergency, it is suggested that a water-tube boiler be erected at the old station to assist the existing battery until the new plant is in working order. Messrs. Babcock and Wilcox have agreed to supply the boiler for £850, which must be paid, out of revenue, as the Council has undertaken to incur no further capital expenditure without the sanction of the L.G.B.

Messrs. Ferranti, Ltd., have agreed to buy back the alternator which they supplied, for £850, a reduction of only £100 on the original purchase price. The water-softener, which is not in use, will probably be sold to the Bath Corporation for £240.

South Staffordshire.—At a meeting of the South Staffordshire Mines Drainage Commissioners last week, the chairman (Col. J. B. Cochrane) stated that there was now a prospect of the Midland Electric Corporation commencing operations in the district, and that the Commissioners were looking forward to electricity becoming a useful power, not only for dealing with water on the surface, but for assisting in draining the mines.

Spain.—A power station is being established at Tiendas Baja, by La Sociedad Mutua-Electra Jaquesa, to utilise the water power of the River Aragon in the generation of electrical energy, which it is proposed to transmit to the town of Jaca for lighting and power purposes.

Spennymoor.—The U.D.C. on August 7th accepted the tender of the Electricity Supply Co. to light a portion of the town with 20 lamps, at 42s. each per annum.

Stoke-on-Trent.—The T.C. has decided to adopt the "Meldrum" Simplex destructor in connection with the proposed electric supply station.

Stroud.—The United Electric Light and Power Board intends to apply for a prov. order for supplying the Council's area, but the Council has already decided to seek powers to supply within its district.

Swinton.—It was reported at the meeting of the U.D.C. on Monday that the Lancashire Electric Power Company would commence the work of providing electric light in a few weeks, and that current would be supplied not later than the commencement of the lighting season of 1903.

Switzerland.—An important project, embracing an expenditure of 5,000,000 lire, with a view to providing electric light and motive power in and around the city of Geneva, is at present under contemplation, and an application for a catchment of water on the Piena has just been deposited with the Minister of Public Works by Signor Antonio Pendola, of Geneva, in this connection. The catchment would be of 400 litres per second with a head of water of 400 metres. The power available would be 2,133 H.P. A reservoir of 7½ millions of cubic metres would have to be constructed.

Sydney.—The report of Messrs. Preece & Cardew, relating to the tenders received for the generating plant for electric supply in the city of Sydney, states that complete tenders were received from 21 firms, most of whom submitted three alternatives, making 58 tenders in all. Of the 11 lowest tenders, five were for plant of British manufacture throughout, four included a considerable amount of plant which would probably be of foreign make, and two were for foreign plant throughout.

Only three patterns of boiler were tendered for, all the firms, except one, quoting the Babcock & Wilcox, and many of them the Stirling as an alternative. The third boiler was of a German make.

Messrs. Preece and Cardew considered that the larger grate area and heating surface provided by the tenders with Babcock boilers were decidedly of advantage, and well worth the extra price. The Babcock boiler had a further advantage, due to the fact that the makers had an office and staff of engineers already in Sydney.

Most of the firms provide for a system of pipe-work and valves, to be supplied by Messrs. Babcock & Wilcox. For the large units the tenders for engines may be divided into high speed of over 200 revolutions, and low speed of about 100 revolutions. The guarantees of steam consumption given with several high-speed engines are so satisfactory that, considering the increased expense of the plant and also of the necessary buildings, crane, &c., with low speed engines, the adoption of the high speed type is recommended. Of the 11 lowest tenders, four included engines made by Browett, Lindley & Co., of Manchester; five by Ferranti, Ltd.; and two by the Augsberg and Nurnberg Machine Works. Of the latter, one was a low speed and the other a high-speed engine. The guaranteed economy in steam consumption of the steam alternators with the Ferranti engine is some 10 per cent. better than that of the sets with Browett Lindley, and Augsberg and Nurnberg Machine Works high-speed engines.

Most of the tenders were from electrical manufacturing firms, and they provided for alternators of their own manufacture. This applied to all the lower tenders, except those of J. G. White & Co. There was very little to choose between most of the machines. As regarded exciting energy, the tender of Messrs. Dick, Kerr & Co., Limited, guaranteed the best results, and their regulation was also good. The five lowest tenders, and also three others, each provided for a battery made by the Tudor Accumulator Company. Practically all the tenders gave satisfactory guarantees of efficiency for the transformers. The designs and prices of switchboards varied considerably, but the Ferranti switch gear was considered to be by far the best, most convenient and safest.

Finally, with plant entirely to their satisfaction, they had the following tenders, viz.:—Dick, Kerr & Co, Limited, £49,072; Mather & Platt, Limited, £50,528; British Thomson-Houston Company, £51,588; J. G. White & Co., £52,444. On the whole they recommended the Council to accept Messrs. Dick, Kerr & Co.'s tender at £49,072, entirely of British manufacture by a purely British firm, although they did not entertain any doubt that each of the other firms would carry out the contract satisfactorily.

The selection of the Ferranti engine enabled them to appreciably reduce the size of the generating station. Should it become necessary to alter their recommendation of the Ferranti engine, they would still adhere to their recommendation of Dick, Kerr and Co.'s tender as the best and cheapest for the rest of the plant. We referred to the Council's decision in our issue of August 1st, p. 193.

Messrs. Preece & Cardew congratulated the Council on the excellence of the tenders as a whole. It was gratifying that the three lowest of the selected tenders should all be from British firms of high standing. There were, however, also very good foreign tenders, and those of Messrs. Siemens & Halske and Brown-Boveri were very near those selected in merit.

Tuileries.—The plans for the lighting of the Tuileries Gardens have been definitely settled. The light will be furnished by 66 arc lamps, similar to those employed in the Avenue de l'Opéra. The installation will cost 95,000 francs, and the annual expense of up-keep is placed at 11,500 francs, which will be shared between the city and the State.

Wakefield.—The City Council has resolved to apply to the L.G.B. for sanction to the borrowing of a further sum of £15,000 for the purpose of extensions in connection with the electricity works.

Walton.—The U.D.C. has received notice of an application of Edmundson's Electricity Corporation, Limited, for a prov. order for electric lighting, and has resolved to apply for an order for the supply of electric light in the district.

Wells.—The Corporation's prov. order having lapsed, Messrs. Crompton & Co., Limited, have offered to refund the cost of a new order for the erection, maintenance, and working of a complete installation for the city, and pay a rental of £30 a year. This is being considered by a committee.

York.—The Electric Lighting Committee recently submitted to the T.C. an exhaustive report on the present position of the electric lighting undertaking of the city, by Mr. C. H. Wordingham, of Manchester, the consulting engineer. Mr. Wordingham reported, amongst other things, that it was imperative that further extensions should be undertaken at once.

The City Electrical Engineer also presented a report on the second year's working of the undertaking, which showed the gross revenue to be £6,110, against £3,802 last year, the gross profit being £2,591, against £1,526 last year. The consumers had increased during the past year to 312, an increase of 35 per cent. The net surplus was £349, against £98 last year.

The total units sold were 423,000; the maximum load was 420KW. The total works costs, per unit, were reduced from 2·46d. to 1·98d., and the total lamps connected at March 31st, were 32,766, an increase of 100 per cent. It is probable that the company will have to stop connecting more consumers, as the plant on order cannot be erected in time for the coming winter; already there are 36,000 8-C.P. lamps connected, and there are awaiting connection some 8,000 8-C.P., while the capacity of the plant is but 20,000 8-C.P. These figures show a remarkably rapid progress, on which Mr. Midgley is to be congratulated.

ELECTRIC TRACTION NOTES.

Aston Manor.—An estimate of £11,352 for the overhead equipment of the tramways has been prepared for the U.D.C. by the electrical engineer (Mr. Wilson), and it has been decided to apply for a loan for the work.

Audenshaw.—The B. of T. has extended the time for the completion of the U.D.C.'s electric tramway until August 3rd, 1903.

Birmingham.—The Dudley Road route of trams is to be converted to the overhead trolley system, and to supply the current a generating station is to be erected at Smethwick. The cars used will be of the eight-wheel bogie type.

Brighton.—The T.C. has received from the Preston Park Ratepayers' Association a requisition, asking it to forthwith take steps to obtain powers to extend the electric trams in the Dyke Road district and from Seven Dials to the sea.

Bury.—After inspecting the Lorain system at Wolverhampton, the Corporation Tramways Committee has recommended the Town Council to adopt the overhead system, and this course has been approved by the Corporation.

Chester.—As was recently stated in our columns, Messrs. R. W. Blackwell & Co., Ltd., have been awarded the complete contract for equipping the Chester tramways on the overhead trolley system. The total value of the contract is over £40,000, which covers the construction of three miles of track and overhead construction, and also the supply of 12 complete cars ready for running. There has been considerable discussion in Chester as to the advisability of operating the tramway on the overhead trolley system, owing to the fear that this would disfigure the town. Messrs. Blackwell have had great experience of overhead line construction, and they, if anybody, will know how to erect the line in the most unobtrusive style.

Crewe.—The Corporation having received several applications for permission to construct electric tramways in the town, has decided to employ an electrical expert to advise as to the probable purchasing value of a tramway undertaking at a given number of years.

Dewsbury.—Considerable progress has been made with the B.E.T. Company's scheme in the heavy woollen district, lines having now been laid from Dewsbury through Ravensthorpe to the Mirfield boundary; from Dewsbury to Thornhill; and also from Dewsbury to the Batley boundary. Lines have also been laid in Heckmondwike, but there is no through line yet from Dewsbury to the Spen Valley, as the Batley Corporation, who own a stretch of road between Dewsbury and Heckmondwike, and who are putting down a municipal scheme, have not yet commenced operations in this portion of their borough. The Traction Company is now laying cables in Dewsbury. It is not expected, however, that the trams will be running much before next Christmas.

Dover.—With reference to last week's note, we are asked to say that the stoppage of the municipal trams was not due to any accident or failure at the generating station.

Exeter.—The City Council last week considered a report from the Electric Traction Committee on the new tramways to be laid down by the Corporation. The Committee recommended that the routes be confined to the city boundary, and that powers be sought to construct 10 lines, making up an aggregate of 8·55 miles of single track, estimated to cost £6,500 a mile, including overhead equipment. The total cost was estimated by the Committee as follows:—Construction, £55,575; car shed and land, £4,000; 14 cars, £8,400; contingencies, £6,797; total, £74,772. Councillor E. C. Perry, chairman of the Committee, in moving the adoption of the report, said that the figure put down as the cost of construction did not include the cost of acquiring the present small system of horse trams nor the necessary plant for generating the current, the latter being a question for the Electric Lighting Committee. The electrical engineer had estimated the cost of the plant at £6,000. After a long debate, the Council adjourned consideration of the report to the following night (7th inst.), when, however, there was not the necessary quorum, and the meeting was adjourned to September 10th.

Great Central Railway and Electric Traction.—At the half-yearly meeting of this railway last week, Sir Alexander Henderson, the chairman, said that tramway competition had again had a bad effect on some of their local services, more particularly in the Sheffield, Nottingham and Grimsby districts, where they estimated they had lost from tramway competition £1,851. They recognised that tramway competition could only be met by improving their own service. The directors were not losing sight of the possibility of adapting electric traction to some portions of their system, and they were watching with close attention the progress being made by some companies in this direction, but they had no intention at the present moment to do more than keep a sharp eye upon what was going on around them.

Glasgow.—Our Glasgow correspondent says:—"Going carefully through the Corporation tramway accounts, I find that the balances are very highly coloured, and that they are put together by the officials so that the lay mind is under the impression that the tramways are fairly coining money. If a company were working the system with the same figures, the net result would be a big deficit, insomuch that the Corporation controlling both the common good, and the tramways, do not press the claims of the former as they would do if the latter were out of their control. To Govan for the 4¼ miles within the burgh boundary, £5,057 3s. 10s. was paid, or at the rate of £1,190 per mile. Now inside the Glasgow boundary there are 41 miles of rails (double), so at the same rate the contribution should be £48,700, instead of £12,500. Thus we should write the results of the past year's workings:—

	Receipts.		
Total receipts	£614,413	4	11
Working expenses	405,103	0	7
Gross balance			£209,310 4 4
Expenditure—Govan trams lease ..	5,057	3	10
Interest on capital	54,282	17	10
Sinking fund	36,974	15	9
Common good	48,700	0	0
Depreciation as per reserve fund account	93,539	15	9
			238,554 13 9
Apparent deficit			£29,244 8 10

Luckily the tramways are not a company concern, and luckier still the rate of interest on loans averages only 2¾ per cent. The report shows a net balance of £6,955 11s. 2d."

The tramways department are experimenting with a speed indicator on some of the cars.

Harrogate.—The T.C. has directed the electrical engineer and borough surveyor to prepare a plan of proposed electric tramways for the town, with the object of the Corporation seeking Parliamentary powers to carry out a scheme.

Hove.—Messrs. Lacey, Clirehugh & Sillar recommend the Council to provide a service of electric trams between the town, Brighton, and Shoreham, of a total length of 7 miles 32 chains. The estimated cost is £103,700 for the overhead system, and £149,700 for the part open conduit system, with an additional £11,400 for the private supply to 15,000 8-c.p. lamps. It is estimated that the yearly profit on the overhead system will be £3,636; on the conduit system, £866; and on the lighting, £816. The Council is recommended to prepare a Bill seeking powers to carry out the work.

Johannesburg.—The T.C., at a recent meeting, had before it a letter, dated July 9th, from Mr. J. G. Hamilton, chairman of the Johannesburg City and Suburban Tramway Company, Limited, stating that Mr. A. Dickenson, expert adviser, had arrived from England, and that they trusted to be enabled to make a start with the running of the company's trams within the next 10 days. In a subsequent letter the chairman stated that his company was prepared to reconstruct the existing tramways and equip them as an overhead electric system, and to have the same in working order within an approximate period of 18 months, after a working arrangement shall have been arrived at. The company was also prepared to construct and equip such extensions to the existing system as may be mutually arranged, and from time to time further extend the system in order to meet the necessities of any particular district. When electrically equipped the company will be prepared:—

(a) To run a five minutes' service of cars on the principal routes within the central area of the town, and a 10 minutes' service on the outer lines, each service to run for at least 13 hours per diem. (b) To run on each working day on all their lines, for the benefit of the working classes, at such hours as may be mutually agreed upon, at least six cars in each direction, the fare of such special workmen's cars to be on the basis of 1d. per mile. (c) To reduce their present fares, and substitute therefor fares on the basis of 2d. per passenger per mile; and to carry children under eight years of age at half price, the stages to be mutually agreed upon. (d) To issue to the public books containing 100 tickets for the sum of £1, such tickets to be available on any stage upon the route; and, further, to issue books containing an equal number of scholars' tickets available for juveniles under the age of 13. These provisions would result in the reducing the fares 1d. per mile in the case of the adult, and 2d. per passenger per mile in the case of scholars. (e) To issue, in the event of the municipality desiring it, 20 free passes entitling the holders to travel upon the business of the municipality on any of the company's cars without charge.

It was pointed out that the cost of installing an electric, or, indeed, any system of tramways in Johannesburg, must be very much in excess of installing and working such a system in either Cape Colony or Natal. The freight cost on rails alone between the coast ports and Johannesburg was in excess of their actual cost delivered in the larger cities of Europe, and therefore fares such as were in force in some of those cities could not be established in a town situated as Johannesburg was. The company's expert advised that the fares quoted were as low as circumstances permitted; but if later experience, consequent on cheapened materials, cheaper labour, or other cause permitted, the company would not fail to effect a further reduction. The company would agree to the proviso that the Council should have the right, at the expiration of 21 years from the opening of the first electric line, to purchase the whole of the undertaking within the municipality upon terms of paying the fair market value thereof as a going concern, without any allowance for a compulsory purchase. In the event, however, of the municipality not being prepared to exercise such right at the expiration of that period, the company was willing that the municipality should have the further right at the end of 35 years of acquiring the undertaking upon paying the then value thereof. Having regard to the reduction in fares, and the increased facilities to be furnished to the public, the company did not anticipate earning large returns from the undertaking; in fact, in the earlier stages, it was estimated that the profits would be but small. The company anticipated, however, that the expected increase in the population of the town and district would prove, in course of time, to be justified by the event, and that, in consequence, the traffic would gradually improve. Under these circumstances, the company was prepared to divide in equal shares with the municipality all profits remaining over after the payment of interest at

the rate of 6 per cent. per annum on the full capital of the company, and after proper provision shall have been made for amortisation and depreciation. Should the municipality desire it, the company was further prepared to find the capital to instal such additional plant at the generating station as would enable it to supply the municipality with electric power in bulk. The conversion of the existing lines and the construction of lines for which authority had already been granted in respect of animal power into an electric system would give an entire system of over 27 miles of streets, and the capital involved would approximate £1,000,000 sterling. A long discussion ensued, and eventually an amendment authorising a Committee to negotiate with the tramways company was defeated by 8 votes to 7, and a proposal to appoint a special committee to consider the establishment of municipal tramways was carried by 10 votes to 5.

Llanelly.—At a meeting of the Council on Monday the Property and Estate Committee reported that they regretted and disapproved of the desire of the British Insulated Wire Company to rescind their agreement with the Council, and they recommended that the Council take the proceedings necessary to compel the specific performance of the contract. The recommendation was unanimously adopted.

Liverpool.—The City Council has, after a long debate, decided to send a deputation to the United States and Canada to inspect the various tramway systems there. It will be composed of the chairman and deputy-chairman of the Tramways Committee, Councillor Lloyd, the manager of the tramways, and the city and electrical engineers.

Mr. C. R. Bellamy, the general manager, in his report, showed that the receipts of the department during the fortnight ending the 26th ult., amounted to no less than £20,991, an increase of £1,067 when compared with the income of the corresponding period of the preceding year. In the two weeks of 1902 the number of passengers carried was 4,490,715, as against 4,280,838 in the like period of the year previously, the increase thus exhibited being 209,877.

At the last meeting of the Tramways Committee, 43 district inspectors, ticket examiners, drivers and conductors were received by the committee, and were presented with certificates of efficiency in "first aid" as taught by the St. John's Ambulance Association. These employés of the Tramways Committee had taken a course of lessons in "first aid" from the local officers of the association, and had passed the examination successfully at the end of the course. In presenting the certificates, Mr. Higginbottom, M.P., chairman of the Committee, congratulated the employés on passing the examination. They might expect, despite of care, he said, that accidents would occasionally happen in connection with tramways undertaking, and it must be a great advantage to the services to have men employed who were able to render assistance. He hoped the help would be promptly given so that relief might be rendered to sufferers.

The first section of the South Lancashire Tramway system—that which connects the city of Liverpool with the towns of Prescot and St. Helens—was opened for passenger traffic on June 24th, and has since been in daily operation. This line, known as the St. Helens section, extends from Knotty Ash to Prescot, and is a little more than three miles in length. The service seems to have at once secured favour. During 44 days the total number of passengers carried was 176,194, being an average of over 4,000 per day. The receipts have been phenomenal. The weekly average has risen as high as 36·62d. per car mile; another week it was 23·69d. per car mile. The explanation of these notable returns is said to be the cheapness of the transit and the frequency of the service.

London.—Some B. of T. officials had a trial trip on Tuesday through Isleworth and Twickenham on the extension of the London United Tramway Company, and the line was opened for regular traffic on Wednesday.

North Metropolitan.—At the half-yearly meeting of the North Metropolitan Tramways Company, Mr. George Richardson said that the Bill for the electrification of the company's lines in Middlesex, the application for which was authorised at the last meeting, had passed both Houses of Parliament, and by arrangement with the Middlesex County Council and the Metropolitan Electric Tramways, it was now proposed to apply to the Board of Trade for their consent to a sale of these lines to the Metropolitan Electric Tramways, and an agreement to this effect would be submitted for confirmation. The arrangement was made between the North Metropolitan Company, the Middlesex County Council and the Metropolitan Electric Tramways, under which the Metropolitan Electric Tramways were to purchase the Middlesex lines of the North Metropolitan Company. Mr. James Devonshire, managing director of the Metropolitan Electric Tramways, was elected to a seat on the board of the North Metropolitan Company.

Lytham.—The conversion of the tramways to electrical working will be completed by March next.

Macclesfield.—The advisability of establishing electric trams in the town is under the consideration of the T.C.

Manchester.—On Thursday, August 7th, a new car shed was opened at Hyde Road in connection with the Corporation tramways. The cost of the new buildings is £50,000, and all the machinery will be electrically driven.

Metropolitan District Railway.—In his speech to this railway last week, Mr. R. W. Perks, M.P., said that the company continued to suffer seriously from tube and electric tramway competition, but the reduction of their fares he thought was wise policy. He referred to the unfairness of the tramway competition, and said that it was an anomalous thing that the tramways company which monopolised the roads and was paying a handsome dividend, paid nothing whatever in contribution to local rates. This was a point which Parliament ought to adjust as between them and other public carriers. The London United Tramways Company, too, caused as much vibration as they did, and was altogether free from any Parliamentary obligation on account of vibration. It was hoped that the Ealing and Harrow Railway would be open for electric traction before the end of the present year. In regard to electric traction, the Metropolitan District Electric Traction Company, who contracted to erect the power house at Chelsea and electrically equip the railway, had become absorbed in the larger Underground Electric Railways of London, with a capital of £5,000,000. The power house was being pushed on vigorously. Mr. Perks referred to the Morgan tube projects, and said that the proposal to carry passengers from Hammersmith to Charing Cross for 1d. was, in his opinion, absurd, seeing that it cost the Central London over 1d. to carry their people over one of the most crowded and popular routes in London.

Newport (Mon.).—Good progress is being made with the erection of standards in the outlying and suburban parts of the borough for the electric traction. The Corporation has accepted the tender of Mr. Krause, Bristol, for £33,750, for the relaying of the tramways, &c. It is expected that the whole of the work will be completed by the end of the year.

Paris.—A cable message states that Paris streets have just had a narrow escape from the introduction of a trolley system. The Est Parisien Company applied to the Municipal Council for permission, provisionally, to instal overhead trolleys until it could change the existing plates, which have been electrocuting men and horses for two years past. The Municipality fortunately remembered that in France "*Rien ne dure comme le provisoire*," and refused the insidious proposal.—*Electrical World.*

The Paris Metropolitan Company has received delivery from the contractors of six, out of nine, sections of the new line on the exterior boulevards, running between the Place de l'Etoile and the Place de la Nation. The part that has just been completed runs from the Etoile to the Square d'Anvers. The stations on the route are:—Etoile, Ternes, Courcelles, Parc, Monceau, Avenue de Villiers, Rue de Rome, Place Clichy, Place Blanche, Place Pigalle, and Square d'Anvers. The stations are now in the hands of the painters, and the rolling stock is all ready. It is expected that this new section will be open for traffic in about six weeks.

Peterborough.—The B.E.T. Co. is to apply for extension of time until September, 1903, to complete its works here.

Reading.—The solicitors to the Cooper Patent Anchor Rail Joint Company, Limited, have informed the T.C. that unless some arrangements satisfactory to their clients are arrived at with respect to the alleged infringement of certain patents in the construction of the Corporation tramways, they will take steps for the protection of their clients. The Corporation on August 7th decided to defend any action brought against the Council.

Sheffield.—The Tramways Committee offers a prize of £5 for the best destination indicator for the electric trams.

Southampton.—At an estimated cost of £7,475 the electric trams are to be extended so as to connect Onslow and Portswood Roads.

Southport.—The T.C. has resolved to ask the B. of T. to sanction a £16,500 loan for tramways extensions.

South Shields.—At a meeting of the T.C. held on 6th inst. it was decided to apply at the next Parliamentary session for powers for the purpose of working the trams by electric traction. Mr. J. H. Cawthra, chief electrical engineer to that borough, was instructed to furnish the Tramways Committee with a report on the various systems of electric traction adopted at home and abroad, and also to prepare estimates for same.

The borough accountant (Mr. J. Bridge) has submitted a detailed statement in connection with the opposition to the South Shields and Sunderland and District Tramways Bill. The expenses of the deputation to London *re* conference with the B.E.T. Co. amounted to £74 16s. 2d.; expenses of deputation, witnesses, &c., *re* Corporation opposition to the Bill in the House of Lords, £399 6s. 4d.; making a total of £474 2s. 6d. In addition, the town clerk reported that the costs and charges of the Parliamentary agents, including counsel's fees, printing, &c., were £485.

South-Western Railway and Electric Traction.—At the half-yearly meeting held last week, in referring to a paragraph in the report, which stated that the Bills of the Metropolitan and Metropolitan District Railway Companies which related to the electrification of portions of the South-Western Company's suburban lines over which those companies possessed running powers, had passed both Houses of Parliament, the Hon. H. W. Campbell (the chairman) said that they were arranging an agreement by which that equipment should be carried out by themselves, but on such terms as would secure an adequate return on the capital they might expend. The agreement also gave them the right to use the equipment for electric working themselves should they at any future

time decide to do so. They would watch the working of those branches very closely, in order that at the proper time they might see how far it would be possible for them to adopt electric traction for their own suburban traffic. Needless to say, they had already gained much useful experience by the working of the Waterloo and City Railway during the past four years. But he might say, that until they had secured their eight lines into the Waterloo Station, it would be premature for them to attempt to adopt electric traction for their suburban traffic. While on that point he might mention that as promised to the shareholders, they offered a strenuous opposition to the proposals of the London United Tramways Company for the extension of their tramways in their district. The unfairness of that competition along public roads which had been largely maintained out of the rates, paid by the company, and in districts which had been brought into being by the facilities which they had afforded, did not seem just, but it was difficult in these days to get Parliament to decline to pass any proposals which were held to give increased facilities to the public, whether those proposals were detrimental to other vested interests created under the authority of Parliament or not. They would watch very carefully the working of that tramway competition, and their officers would carefully study the effects of similar competition there and elsewhere, and they might rest assured that the directors would do their best to protect the interests of the shareholders. Mr. Newby, a shareholder, said he was afraid that the diminution which the chairman had referred to in the third-class passenger traffic, was due to the competition which the company now had to meet with electric trams, and he was afraid as years went on that that competion would become more and more keen.

Spain.—Plans for a projected electric railway between Fermoselle, Lunibrales, and Vitigudino are being prepared. Water power would be utilised in the generation of the necessary electrical energy.

Stroud.—At the monthly meeting of the U.D.C. on 8th inst., Mr. Holloway, a large clothing manufacturer, said it was nothing short of a calamity to the district, that the proposed scheme of light railways had been rejected by the Commissioners. However, he hoped it would not be long before Stroud possessed a complete system of electric tramways. Other members spoke similarly, and it was decided to appoint a special committee to report upon the best means of introducing electric power, traction and light into the district.

Sydney.—In the *Sydney Daily Telegraph* recently an interesting article appeared on the progress that is being made with the electric tramway system extensions there. We gather that for some months past the authorities who have in hand the big scheme for the complete conversion of the Sydney tram service to electricity have been quietly, but steadily, pursuing a course of operations which so far has produced very satisfactory results. The new power house at Ultimo, with its immense chimneys, may safely be termed the largest building of its kind in the Southern Hemisphere, and in the matter of output of electrical energy it will probably remain the most gigantic undertaking in the Commonwealth for some years to come. The immense generators which, in the near future, will be capable of supplying all the necessary electric current for running the cars on the various tramway routes, are now being got ready. The new switchboard is practically completed, and a staircase is being built to reach it from various parts of the power house. There will be six generators in the new power house. Of these, three are all but in their places, and the work of putting the others together and fixing them in position will be carried out without delay. The large coal bunkers are nearing completion. A good deal of the work of laying the cables, which are to carry the high tension alternating current to the sub-stations at Newtown, Parliament House, Randwick, Waverley, and North Shore, has been accomplished. These cables have to be tested up to 20,000 volts. The first conversion will be made as far as Bondi. The sub-station at Waverley is already completed, and the batteries have been installed. The cables from the power house are nearly completed as far as the new site, but a considerable amount of work has yet to be done before the Waverley car shed will be ready for rolling stock. Although the batteries are in place at the Waverley power house, it is at present impossible to use them in any way, either with the direct current or the high tension current. At Randwick, however, some use is being made of the direct current in the new power house just erected near Allison Road. There has for some time been a line of direct current from the older power house at Ultimo as far as the sheds. It has been used for the electric cars that run to the racecourse. As the batteries are already in position at the Randwick power house, the department is now able to store current there for use in cases of emergency or heavy working. The cables to carry the high tension current, when the Ultimo scheme has been completed, have already been carried as far as the Randwick building. At the city (Parliament House) and Newtown sub-stations, all the electrical machinery and batteries to be used in connection with the new system have been fixed, and are only awaiting the turning on of the high tension current. So far as North Shore is concerned, most of the work for that station is already in hand.

Vesuvius.—It is stated in the *Chronicle* that Cooks are interested in a project for an electric railway to run direct to Mount Vesuvius from the naval arsenal in the city of Naples, thus affording increased facilities to the 30,000 to 50,000 tourists who visit the crater annually. The faculty of science in the Naples University opposes the scheme, and contends that the proximity of the line to the University Observatory on Vesuvius would interfere seriously with the scientific value of the records on the seismic instruments, which register the slightest earth tremors, and measure their inherent energy with the utmost precision. The faculty further urges that a powerful electric train on the mountain even at a distance from the observatory could not help affecting injuriously other magneto-electrical scientific apparatus already installed or about to be installed there by the Royal University.

Worcester.—The T.C. has entered into an agreement with the B.E.T. Co. to convert the tramways to electric traction.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	..
Communication with Carthagena and Barranquilla (Columbia)	Dec. 8, 1900	..
Trinidad-Demerara No. 1	Aug. 27, 1901	..
Communication with Bolama	April 18, 1902	..
St. Lucia-St. Vincent	May 8, 1902	..
St. Lucia-Grenada	May 8, 1902	..
Dominica-Martinique	May 8, 1902	..
St. Lucia-Martinique	May 8, 1902	..
Guadeloupe-Martinique	May 9, 1902	..
Santa Cruz de Teneriffe to Tejita de Teneriffe	July 4, 1902	..
Puerto Plata-Martinique	July 10, 1902	..
Anjer-Kalianda	Aug. 2, 1902	Aug. 11th, 1902.
Guantanamo-Mole St. Nicholas	Aug. 5, 1902	..
Nagasaki-Fusan (between Tsushima and Fusan)	Aug. 5, 1902	..
Landlines :—		
Route *via* Hanekin on Persian territory	Feb. 24, 1900	..
Communication with Tientsin and Taku *via* Helampo	July 18, 1900	..

American Pacific Cables.—According to a *Reuter* telegram from Washington, President Roosevelt has granted the application of the Commercial Pacific Cable Company, which purposes to construct a cable from San Francisco to China, with landings at Hawaii, Guam, and the Philippines. The President has also granted the company access to certain charts of soundings and profiles of the ocean-bed, belonging to the Navy Department. The conditions on which the application is granted are that the rates shall not exceed those fixed by the United States Government; that Government cablegrams shall have priority; that the Government shall have the right to purchase the cable at any time at a value appraised by disinterested persons, and to assume full control of it when the country is at war, or when war is threatened; that all contracts with foreign Governments for the transmission of messages shall become null when the United States is at war; that the United States shall have authority to sever the branches connecting the main cable during war, or when war is threatened; and that the line from the Philippines to China shall be constructed by the company independently of all foreign companies and concerns.

Grantham Telephones.—We hear that the T.C. has temporarily suspended further operations for the exploitation of the proposed municipal telephone system.

International Telegraph Code.—Both the Bombay and the Bengal Chambers of Commerce have memorialised the Government of India against the compulsory adoption of a new official telegraph code to be promulgated in accordance with the decision of the international conference held at Budapest in 1896. They ask that the delegate for India at the international conference to be held in London next spring should be given instructions to use his best endeavours to prevent the ratification of the vocabulary for compulsory use.—*Times.*

International Telegraph Conference.—It is stated that Belgium will be represented by the Director-General of Telegraphs at the forthcoming international telegraph conference in London.

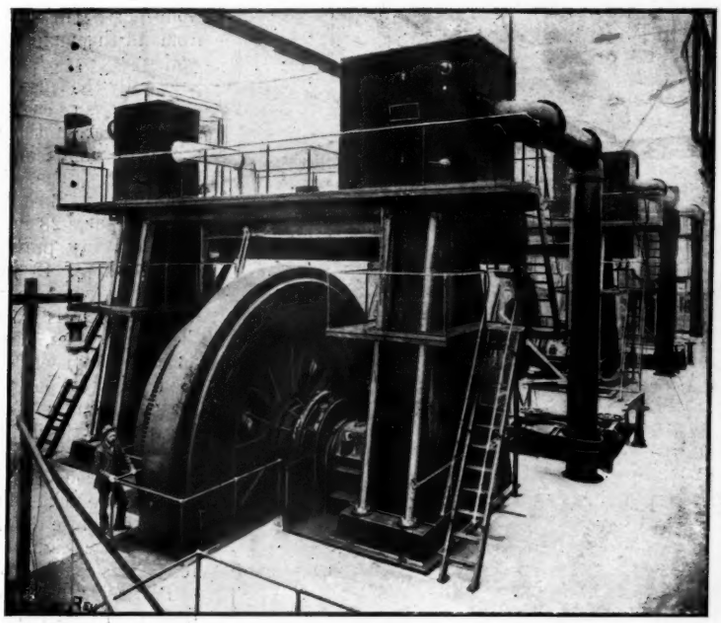
Oldham Telephones.—The T.C. is to apply for a telephone license for the Oldham Exchange area.

Pleasures of Cable Laying.—It is stated that the cable steamer *Anglia*, while laying recently the Norfolk Island to Fiji section of the Australasian cable, encountered a cyclone which lasted ten hours. No one could pass along the deck, the speed of the ship was reduced, although full power was maintained, and all had to remain at their posts. The cable was not lost, however, but the course was preserved and the work done creditably. An experience of this kind is a good test of the training of a cable ship's staff and crew.—*Electrical World.*

The Telegraph Wire Export Trade.—The fluctuating character of the export trade of this country in telegraphic wire and apparatus connected therewith is well shown by the returns which are now available for July. The shipments during that month alone exceed the whole of those during the first half of the current year; they reached a value of no less than £397,601, which compares with only £46,866 in June last, and £53,140 in July, 1901. Last month's activity has entirely altered the position of this branch of industry; for while at the end of the half-year the returns exhibited a decline of over £800,000, they now show the largest totals recorded in recent years. To give the figures, the aggregate shipments during the seven months ending with July last have amounted to £1,784,786, which contrasts with £1,772,500 in the corresponding period of last year, and £1,665,016 in the first seven months of 1900.

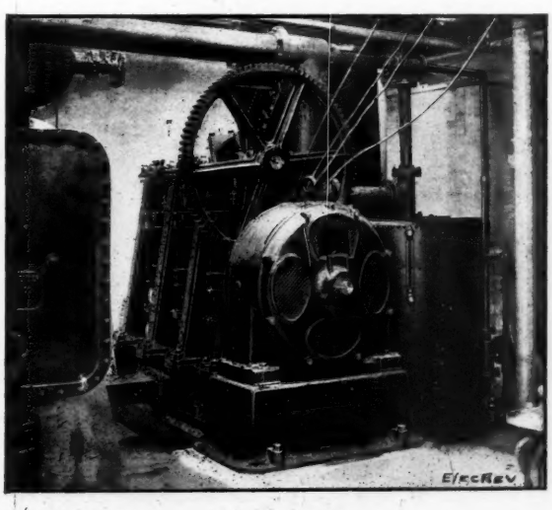
ELECTRIC LIGHTING AND POWER IN SAN FRANCISCO.

The city of San Francisco is exceedingly prosperous, and is rapidly growing, having many extensive industrial centres scattered over a wide area. Electric lighting and power has been freely used there for many years past, but with the ever-increasing business, the necessity for having some electrical system of such a form, and sufficiently extensive as to give the best possible results, became very pronounced, and resulted in the formation of the Independent Electric Light and Power Company. This company commenced to supply the city with electricity last year, and the way in which it has arranged the details of its generating and distributing system, no less than the large size of the whole equipment put down, is most convincing evidence that it realises the fact that San Francisco cannot continue in its prosperity without the aid of electrical power, and plenty of it. The system put down is one best suited for the conditions existing in the neighbourhood; long distances have to be traversed by the current, and heavy loads centred at widely distant points have to be undertaken with economy, and with perfect safety and reliability. Consequently, a high-pressure, polyphase, alternate-current transmission has been adopted, and the machinery and details installed in connection with the same are of the most modern, yet well-proved and well-tried types. Such being the case, a description of the system will be both interesting and valuable. In general the system adopted consists of two-phase current generation, three-phase transmission, two-phase alternate current distribution, and also direct current distribution.

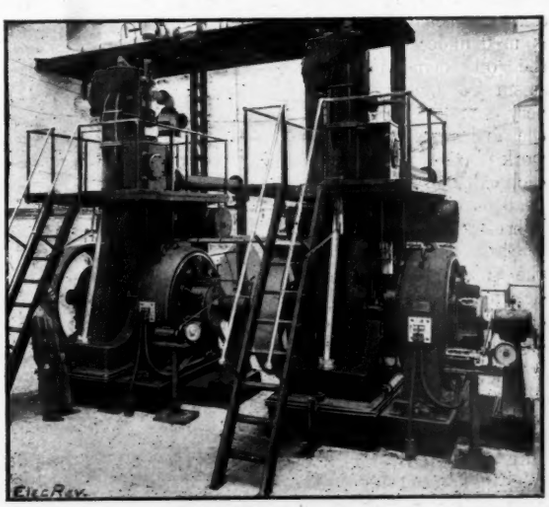


Westinghouse Two-Phase Steam Alternator.

The main generating plant consists of steam-driven alternators, four of 1,500 KW. capacity, and one of 500 KW. capacity. Steam for these generators is drawn from a battery of 12 Babcock and Wilcox boilers of the largest size in general use as made in this well-known type. They are put down in separate pairs, each being divided from the others by a substantial wall, so that any boiler may be in operation or standing without interfering with any other. In each furnace are 252 tubes of lap-welded wrought-iron, each 18 ft. long and 4 in. in diameter. The boilers were all tested and made tight under a hydrostatic pressure of 300 lbs. per sq. in. They work in conjunction with sets of Green's economisers, which are fixed at the rear of the boilers, and on either side of the steel chimney. The flues are thus short and straight, and are arranged with by-passes and the requisite dampers, so that any economiser may be thrown either into or out of use as desired. On each side of the smoke stack at its base is installed a circular fan, 10 ft. in diameter, direct-driven

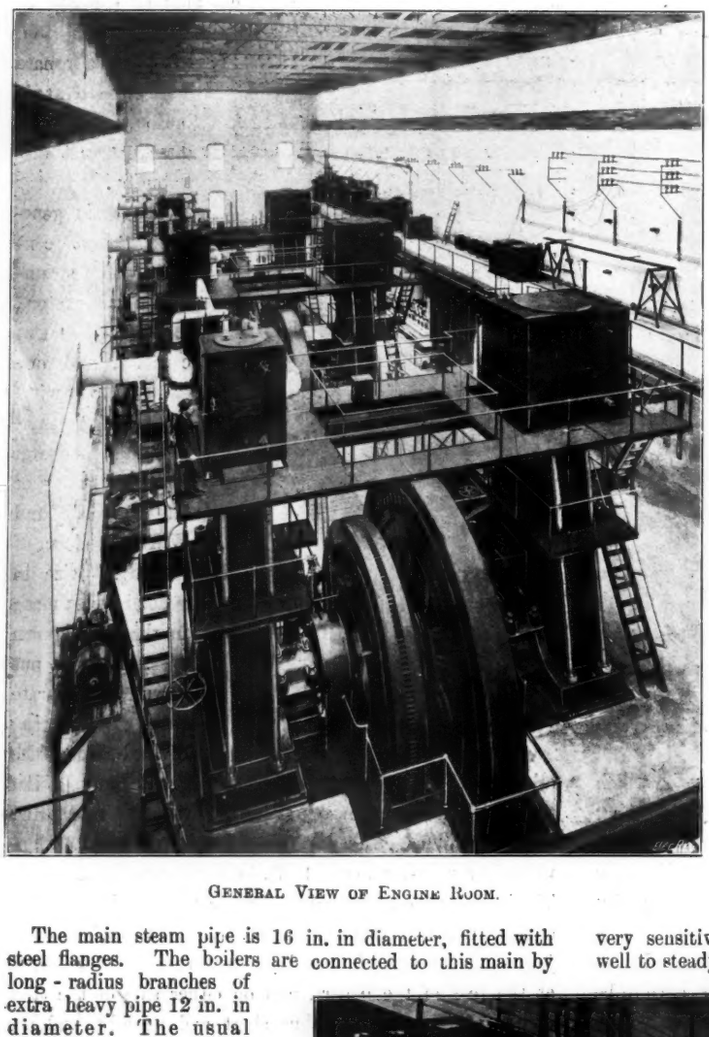


Condensing and Pumping Plant.



Steam-Driven Exciters.

by a horizontal steam engine for providing forced draught when necessary. The normal working pressure of the steam system is 165 lbs. per sq. in.



General View of Engine Room.

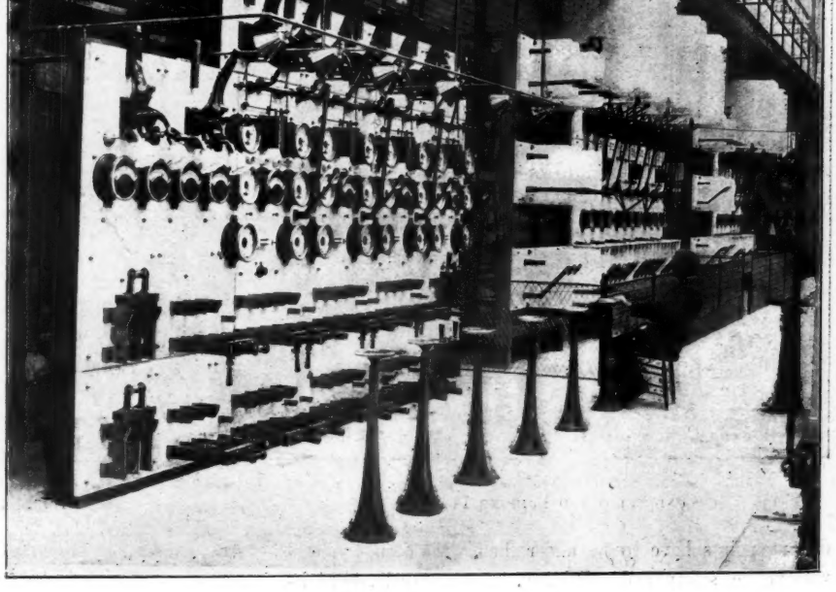
The main steam pipe is 16 in. in diameter, fitted with steel flanges. The boilers are connected to this main by long-radius branches of extra heavy pipe 12 in. in diameter. The usual separators, isolating valves, &c., are fitted. Oil fuel is used under the boilers, the oil being burnt in steam jet burners of a very simple form. All the main steam engines work condensing, and each exhausts into an independent condenser of the Wheeler type.

Circulating water for the surface condensers is drawn from the Bay of San Francisco, the pumping plant being installed in a separate power house about 500 yards from the main works. Here four centrifugal pumps, each direct driven by a 30-H.P. Westinghouse type "C" induction motor, draw the sea water from the Bay, and force it to the boiler house through a 30-in. main. The pumps have no load imposed upon them for the return of the water, which is allowed to siphon back through a 30-in. discharge pipe. Each condenser outfit consists of a surface condenser and a vertical triplex air pump. One of the latter is shown in one of our views, direct coupled to a Westinghouse two-phase alternate current motor. The boiler feed pumps are three in number, of the Snow duplex type, the feed water being driven from these through two large feed water heaters of the Goubert type, into which the exhaust steam from all the auxiliary pumping plant of the works is passed, and in which it is practically condensed.

The steam engines driving the main generators are of the cross-compound vertical type; four of them are rated at 2,400 I.H.P. each, the fifth one being smaller, and having a capacity of 760 I.H.P. The larger engines have cylinders 28 in. and 58 in. in diameter, high and low pressure respectively, and an even stroke of 48 in. Their normal speed is 116 revolutions per minute. The smaller engine, which is exactly similar in form to the larger ones, has cylinders 17 in. and 36 in. in diameter, a 30-in. stroke, and runs at 160 revolutions per minute. The high-pressure cylinders of these engines are steam-jacketted both in the barrels and covers. The coils of the reheating receivers are in series with the steam jackets, the object being to secure a quick circulation of steam through the system, since the difference in temperature between the high-pressure cylinder and the receiver is considerable.

Particular care has been taken with the design of these engines to render them expressly suitable for the driving of alternators in parallel. The governors are all under the control of small electric motors, which are arranged so that the speed of any engine running may be varied at will over a considerable range by the switchboard attendant of the station.

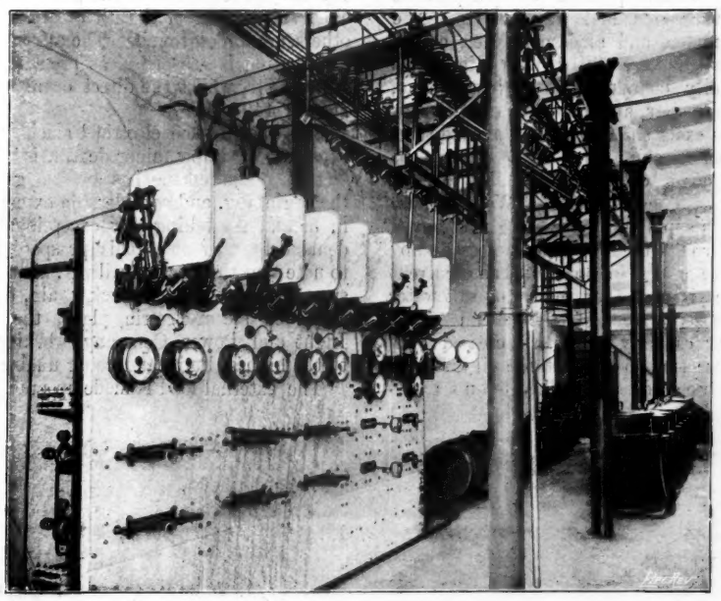
The governors are well damped to prevent momentary changes of speed due to sudden fluctuations in the electric load. They are very sensitive over a wide range, and adapt themselves well to steady changes of load or steam pressure. Careful tests have shown that the engines work perfectly in



Main Switchboard in Power Station.

parallel. A sudden cutting-off of the full load of one of the large sets causes only a momentary rise of 4·5 per cent. in speed. The gradual change of load from maximum to zero resulted in a rise in speed of 0·46 per cent.

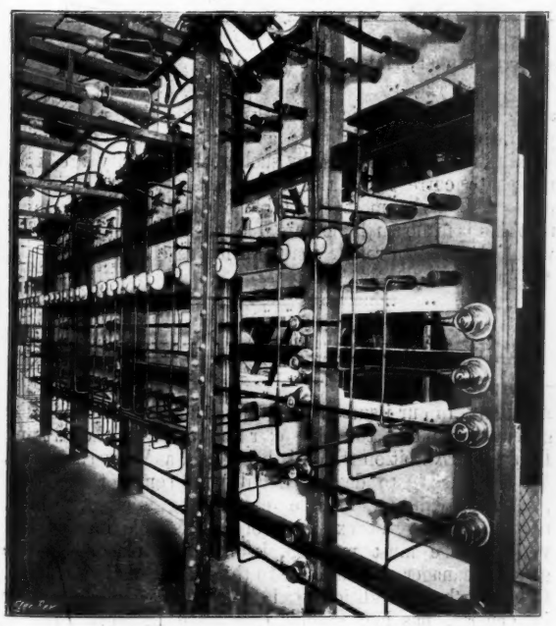
A good general view of a portion of the engine-room plant is shown in two of our illustrations. It will be seen that the electrical generator is carried alongside the fly-wheel on the centre of the main shaft between the high and low-pressure sides. The fly-wheels are built up in sections; these are shrunk and bolted together, and the wheel turned true after being fixed to the shaft. The alternators are of the standard Westinghouse rotating armature type, the armature being built up on a cast-iron spider, which is pressed on to the shaft alongside the fly-wheel by hydraulic pressure. The armature core is built up of soft-steel plates in segments assembled together and dove-tailed into the outer rim of the cast-iron supporting wheel. The periphery of the core is slotted to receive the armature conductors, which are of flat copper bars, insulated before being placed in the slots. Particular care has been taken in the construction of these machines to ensure efficient ventilation; the core plates are spaced, and the cast-iron rim cored out to give continuous channels through which a constant stream of cool air is forced whilst the machine is running. There are 62 poles in the field. They are carried on the inside of a cast-iron ring surrounding the armature, and consist of soft-steel stampings assembled together, and cast into the body of the ring which forms a continuous yoke to the magnetic circuit. Each pole-piece bears a coil of the field winding. The coils are of copper, strap-wound edgeways on formers, which are held in place by lugs screwed to the cast field ring. These formers slide easily into position on the pole-pieces; the coils are thus readily fixed or detached, and are well ventilated. The field ring is vertically divided, the halves being set on guide plates and fitted with gears by which they can be easily drawn apart and all parts of the machine exposed for inspection or repairs. The large sets each yield 1,500 KW. in the form of two-phase current, at a pressure of 500 volts per phase. The guaranteed full-load efficiency of these generators is 95 per cent., whilst after 24 hours' run at full load their temperature rise will not exceed 40° C., and at 50 per cent. overload for one hour the rise in temperature will not exceed 60° C. The smaller generator of 500 KW. is similar to those described.



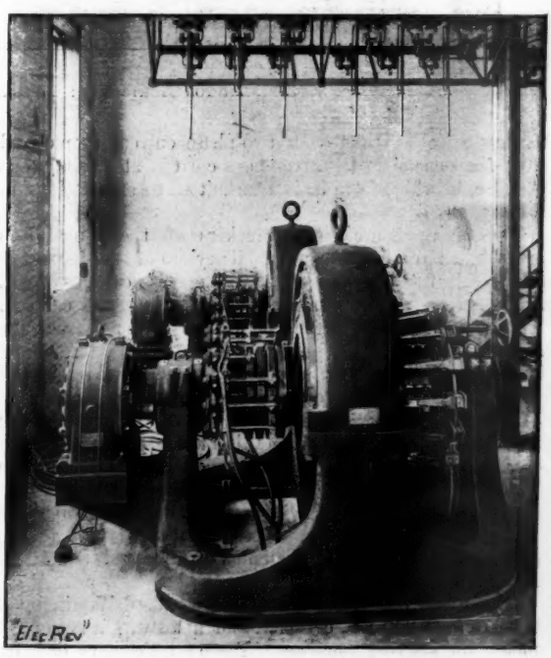
Switchboard in Sub station.

The exciting plant, of which we give a view, consists of two direct-driven units, each of 100-KW. capacity, yielding current at a pressure of 125 volts. The engines driving these machines are of the vertical tandem compound type, fitted with piston valves, and having cylinders 11 in. and 19 in. in diameter respectively, the stroke being 15 in., and the normal speed 200 revolutions per minute. The generators are of the standard Westinghouse multipolar direct-current type, direct coupled to the driving engines.

A general view of the main switchboard at the power



Back of Main Switchboard.



Rotary Converters in Sub-station.

station is given on p. 268. The whole board is built up of white marble panels supported on an iron framework and fitted with the usual switches, instruments, &c., in accordance with the well-known standard Westinghouse practice. Provision is made for either parallel or independent running of the generating sets and transformers. The switchboards are very complete and modern in their equipment. The circuit-breakers are fitted with time-limit devices, and a particularly complete set of instruments, including wattmeters, voltmeters, and ammeters of all forms, is provided, and gives an exact showing as to the conditions existing in any part of the circuit.

The step-up transformers originally installed are of 750 KW. capacity each. They are of the Westinghouse water-cooled type, a fresh supply of water being maintained in constant circulation through them by means of a Quimby pump direct connected to a Westinghouse alternate current motor. The fresh water is cooled by means of salt water drawn from the condenser system of the steam plant. Recently the transformer capacity has been increased very largely, and Westinghouse transformers of the oil-insulated self-cooling type have been adopted. The step-up transformers raise the 500-volt two-phase current as received from the generators to three-phase current at 11,000 volts pressure, in which form it is transmitted to sub-stations in the city.

The high-pressure circuit-breakers of the sub-stations are installed in a novel manner. They are of the single-pole long-break fused type, of 150 amperes capacity each, supported on an iron pipe framework from the ceilings. An idea of this arrangement will be gathered from the illustration.

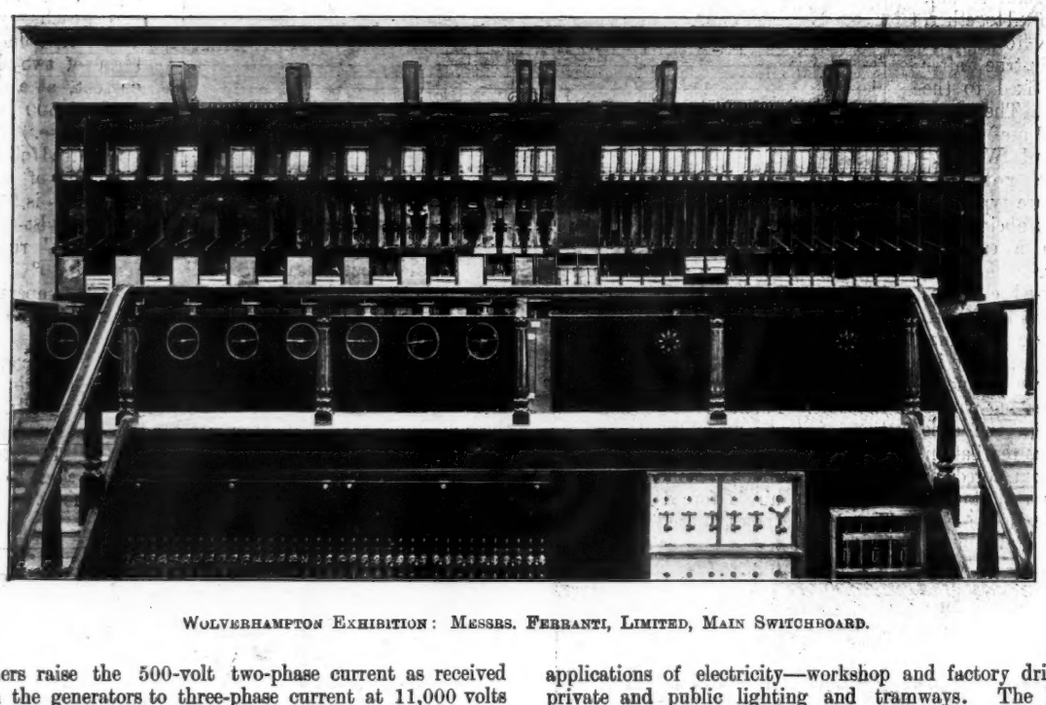
At the Eighth Street sub-station there are three sets of 400-KW. transformers reducing the three-phase current of 11,000 volts pressure to two-phase current at a pressure of 2,000 volts. In addition to this alternate current supply there is also a three-wire direct current distribution system which receives its supply from rotary converters. At the Eighth Street sub-station the rotary converter supply is utilised chiefly for traction purposes, and this is also true of the Sunnyside Station of the San Francisco and San Mateo Electric Railway system.

The rotary converters are of the standard Westinghouse type, each of 250 KW. capacity, and fitted with a type "C" motor for starting purposes. These rotaries have done excellent service in connection with the supply, particularly those used in connection with the electric railway already mentioned, which were constantly subjected to overloads even up to points between 100 and 200 per cent. A good view of a pair of the rotary converters as installed is shown in one of our views, which also shows the starting motors and the high-pressure circuit-breakers overhead.

The underground mains are of paper-insulated, lead-covered cables, laid in terra-cotta conduits. The main 11,000-volt feeders from the power station at Portrero to the chief sub-station at Eighth Street, and thence to the three others, are underground. The alternate current low pressure distribution is two-phase, at pressures of 115, 230, 440, or 2,300 volts, whilst the direct current is distributed at 110, 220, or 440 volts.

The whole of the electrical machinery put down, with the exception of a few minor details, is of Westinghouse manufacture. The scheme has been a great success right from the beginning, and considerable extensions have been always in hand. As telling how exceptionally great has been the demand for current in this prosperous city, it is interesting to note that the electric railway, already mentioned as a consumer, has had to go back again, for a time, to its once discarded steam-electric plant, the Independent Electric Light and Power Company working their plant right up to the highest limit, and being unable to produce more.

The external load is made up practically of all every-day applications of electricity—workshop and factory driving, private and public lighting and tramways. The most striking features evidenced by such real prosperity are, that polyphase current for the generation and distribution of power forms the most adaptable and reliable system, and that this is in no small measure due to the state of perfection which the modern rotary converter has reached.



WOLVERHAMPTON EXHIBITION: MESSRS. FERRANTI, LIMITED, MAIN SWITCHBOARD.

THE WOLVERHAMPTON EXHIBITION.

ALREADY, in our issue of May 2nd, 1902, we have given a general account of the character and scope of the Art and Industrial Exhibition which is being held at Wolverhampton. We now propose to deal in detail with some of the more prominent exhibits in the engineering section, which, though not of great extent, is of considerable interest and variety. We must mention, in the first place, that the general manager and engineer to the Exhibition is Mr. J. H. Cundall, who, in addition to a large experience in engineering in general, has had special experience in work of this description. Mr. Cundall's assistants in the engineers' department are Mr. P. C. Cannon, assistant engineer; Mr. A. C. Freeman, assistant electrical engineer; and Messrs. J. Barnett, E. Howell, and W. Peebles. Mr. Freeman has had charge of the whole of the arrangements for the generation

and distribution of electricity for light and power throughout the Exhibition, as well as the installation of gas lighting, and having occupied the position of chief assistant electrical engineer for the Glasgow Exhibition last year, in which his efforts were entirely successful, he has been able to achieve a similar success at Wolverhampton. The decorative electric illumination of the exterior of the buildings, for which he was responsible, has been carried out in an exceptionally thorough and artistic manner, and at moderate cost.

The electric generating plant has been for the most part concentrated in an enclosure near the centre of the Machinery Hall, and provides both for lighting and for the supply of power to the whole of the machinery in motion. The electric power is controlled by a large Ferranti switchboard, from which it is distributed on the three-wire system, exactly after the style of an installation for the supply of a small town. The main cables were supplied by the British Insulated Wire Company, Limited, and are of the triple concentric paper-insulated lead-covered type, laid in wood conduits. The cables for indoor arc lighting circuits and glow lamp branch circuits were supplied by Messrs. Isidor Frankenburg, and are insulated with vulcanised rubber. The main buildings and the grounds are lighted with Brockie-Pell arc lamps, worked 10 in series on the 500-volt outers of the distributing system at 10 amperes. Exhibitors' stands are fitted up on the distribution board system, with three-ampere circuits for lighting; motors up to 5 H.P. are run off the 250-volt circuits, beyond that power off the outers. The wiring for the arc lamps in the grounds was done with bare aluminium overhead wire, lent by the British Aluminium Company.

The main switchboard, of which we give an illustration, is one of the most striking exhibits, and presents a very handsome appearance. It is of Messrs. Ferranti's standard cellular type, and consists of eight generator panels, eight feeder panels, and the necessary provision for the neutral wire and the balancers. Each panel is complete in itself, with all necessary switches, cut-outs, regulators and measuring instruments. A generator panel contains an edge-wise ammeter, two quick-break switches, one of which is operated by an automatic device fixed in a recess under the switch, and a fuse. The automatic device opens the switch in case of reversal of current. The ammeter and fuse slide into place, making contact with spring jaws, and a duplicate set of contacts provides for the substitution of one fuse for another without interrupting the circuit. Edgewise voltmeters are mounted on the top of the board for paralleling and for reading the bus-bar pressure. The regulating resistances, of the Ferranti open type, are placed under the switchboard platform, and are operated by means of handwheels in front of the corresponding panels. Field switches are also provided on the regulating table.

The main bus-bars run from end to end of the board, traversing all the dynamo and feeder panels; they are encased in ebonite in alternate compartments, so that only one bar is exposed in any one compartment.

Each of the feeder panels contains two ammeters, two single-pole switches, and two sets of fuses. Two feeder voltmeters are mounted on the top of the board, and coupled up to the voltmeter switches on the front of the regulating table.

The switches for the balancer and the earth and mid-wire ammeters are placed at the centre of the board, the starting switch for the balancer being placed under the regulating table in front of the board.

The overall dimensions of the board are 23 ft. 8 in. × 13 ft. high; it is entirely on the front of the wall, into which it is cemented, and all parts are accessible from the front. The paralleling device is very similar to the well-known Ferranti synchronising device for alternate current work; and the switches themselves are exceptionally strong, with large cross-section of metal and contact surface. The fuses are of the oil-break type employed by the firm for high pressure A.C. work, suitably strengthened.

In front of the board, on a lower level, may be seen a row of double-pole switches for the arc lighting circuits.

Of Messrs. Ferranti's other exhibits we shall make mention later.

(To be continued.)

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—August 19th. Nine arc lamps and pillars for street lighting. See "Official Notices" August 8th.

Amsterdam.—September 8th. Underground high pressure and low pressure cable system (three-phase, direct and telephone). See "Official Notices" July 4th.

Austria.—August 25th. The Austrian State Railways Administration, Pilsen, require supplies of arc and incandescent lamps and cables for lighting purposes. Offers should be received before August 25th.

Bexley.—September 4th. Permanent way, bonding, overhead equipment, car bodies, trucks and equipment. See "Official Notices" to-day.

Bristol.—September 10th. Electric wiring, bells, telephones; also boilers, economisers, piping, &c, for the Guardians' Infirmary. See "Official Notices" August 8th.

Christiania.—September 13th. Sealed tenders marked "Telegrafog-Telefonmateriel" will be received at the Board of Managers' Office, Christiania, up to 3 p.m. on the 13th prox, for the supply to the Norwegian State Railways of the undermentioned goods:—22,000 kilogs. of telegraph wire, No. 8, galvanised iron wire, 4·1 to 4·3 millimetres diameter; 5,400 kilogs. of telegraph wire, No. 11, galvanised iron wire, 3·1 to 3·3 millimetres diameter; 3,600 kilogs. of copper wire, 2·4 to 2·6 millimetres diameter; 5,900 porcelain insulators; 5,900 insulator holders. Tenders may include part or all of the goods required. Further particulars can be obtained on application to the office of the Inspector of Telegraphs, Stoners Gade, Christiania.

Doncaster.—August 28th. Ejector condensing plant, &c. See "Official Notices" to-day.

Dresden.—October 1st. A competition for a safety apparatus in connection with the working of electric tramways will be decided on the date mentioned by the Communal Administration of the town of Dresden (Saxony). Three prizes of 5,000, 3,000 and 2,000 marks will be awarded.

Edinburgh.—August 26th. Cast-iron pillar boxes for street section fuses. See "Official Notices" to-day.

France.—August 20th. Tenders are being invited until the 20th inst. by the French Post and Telegraph authorities in Paris for the supply of 300 tons of copper-wire in six lots. Tenders are to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle 103, Paris, whence particulars may be obtained.

Harrogate.—August 18th. Electric wiring at the Kursaal for the Corporation. See "Official Notices" August 8th.

Huddersfield.—August 18th. Motor-driven tower waggon for overhead equipment work. See "Official Notices" to-day.

Ilford.—August 19th. Combined watering and sweeping car with equipment. See "Official Notices" July 25th.

Italy.—August 26th. The Municipality of Maddaloni (Caserte), Italy, will on this date consider applications for the concession of the electric lighting of the town for a term of 40 years.

Kala Lumpur (Selangor State).—August 21st. Two 600-H.P. turbines, two 400-KW. three-phase generators, switchboard, motor-generators, poles, wire, &c., for transmission line, arc and glow lamps, &c., for the Crown Agents for the Colonies. See "Official Notices" July 11th.

King William's Town (Cape Colony).—September 1st. Sealed tenders for electric lighting plant, &c., as per specifications, will be received at the office of the King Electric Lighting and Cold Storage Company, Limited, King William's Town, Cape Colony, until noon on Monday, September 1st, 1902.

Launceston (Tasmania).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

Leicester.—September 3rd. Tram rails, points, crossings, conduits, cables, overhead equipment, bonding, boilers, engines, generators, and other power station plant; also electric cars for the Corporation. See "Official Notices" July 18th.

Malvern.—August 23rd. Lancashire boilers, engines, alternators, cables, transformers, switchboard, &c., for the Council's electricity supply scheme. See "Official Notices" July 11th.

N.E. Railway.—October 7th. The directors are inviting tenders for the complete electrification of about 37 miles of standard gauge (double track mostly) line in the neighbourhood of Newcastle. The contract is divided into two sections—(1) electrical equipment of coaches and permanent way; (2) high-tension cables and sub-station equipment. For further particulars see our "Official Notices" July 25th.

Newport.—August 20th. Electric generating plant and wiring, &c., for the new lunatic asylum at Caerleon. See "Official Notices" July 25th.

Northfleet.—The U.D.C. is desirous of entering into a contract with some company for the working of its electric lighting order. See "Official Notices" July 25th.

Pemberton.—August 20th. Complete electrical installation (boilers, engines, dynamos, &c.), cables, rails, &c., and overhead equipment. See "Official Notices" August 1st.

Poplar.—August 25th. Arc lamp carbons for Electricity Committee. See "Official Notices" to-day.

Roumania.—September 3rd. The municipal administration of Calarasi-Stirbey (Roumania) is prepared to receive tenders for the concession of establishing and working the electric lighting service of the town.

Rugby.—August 20th. One 150-KW. and one 60-KW. high speed steam three-phase alternators; switchboard, mains, lamps, and meters for the U.D.C. See "Official Notices" August 1st.

Spain.—August 18th. The municipal authorities of Daroca (province of Zaragoza) are inviting tenders until the 18th inst., for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to El Secretario del Ayuntamiento de Daroca (Zaragoza), whence particulars may be obtained.

Stretford.—August 30th. The U.D.C. invites tenders for the building of an electricity generating station, adjoining Lonford Bridge, Stretford.

Swansea.—September 1st. Telephone conduits, cables, wires, batteries, instruments, switchboards, &c, for municipal telephone equipment. See "Official Notices" to-day.

Tien-Tsin.—November 30th. The *Times* says that the Board of Trade have received through the Foreign Office from his Majesty's commercial attaché at Shanghai a copy of an advertisement issued by the Municipal Secretary at Tien-Tsin calling for proposals for the lighting of the British concessions by electricity which reads as follows:—"British Municipality and British Municipal Extension, Tien-Tsin.—Notice.—The British municipal councils, in accordance with the terms of the resolution passed at the general meeting of landowners, fners, &c., held on May 2nd, 1902, are now prepared to receive proposals for the lighting of the concessions by electricity, such proposals to be submitted not later than November 30th of this year.—A. W. Harvey Pellingham, A.M.I.C.E., Secretary and Engineer." It is understood that no details or specification will be furnished.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

CLOSED.

Belgium.—La Société Nationale des Chemins de Fer Vicinaux, of Brussels, has just opened the tenders for the supply and erection of the overhead conductors for the electric local railways between Grâce Berleur and Hallogne, and between St. Walbarge and Vottem in the Liège district. Six tenders—three Belgian and three German—were altogether received, the lowest being that of the Compagnie Internationale d'Electricité, of Liège.

Bolton.—The Municipal Technical School at Bolton has just placed an order with Messrs. Witting Bros., Electrical Engineers and Contractors, Limited, for the preliminary equipment of its new dynamo room. The order comprises single and polyphase alternators, single and polyphase motors, direct current motors, transformers, a rotary converter, and a complete switchboard. Messrs. Witting Bros. have also recently received an order from the Brompton and Kensington Electricity Supply Company, Limited, for two motor-generators, each consisting of a Heyland motor driving a continuous current generator, for accumulator charging.

Bradford.—Cole, Marchent & Morley are to supply two grease separators for Valley Road generating station, for £560; the tender of the B.T.H. Co. for the supply of lamps required for free distribution during the half-year ending December 31st, for £306, and that of Mr. G. A. Steinthal, of Bradford, for the work required in connection with the lighting of the new fire brigade station at £260 have been accepted.

Bradford.—Miller & Co., of Edinbro', have received an order for an improved car wheel grinder for the Thornbury car depôt at a cost of £270.

Breconshire.—The contract for lighting the Joint Welsh Counties Asylum, which is being built in Mid-Breconshire at an outlay of nearly £120,000, has been entrusted to Mr. Watkin Williams, of Pontypridd, in conjunction with Messrs. Graham Brothers, of Middlesborough.

Bury.—The T.C. has accepted the tender of Messrs. Walmsley & Co., Ltd., Bury, for condensing plant, and that of Messrs. G. & J. Weir, Ltd., Glasgow, for feed pump.

Eccles.—The T.C. has accepted the tender of the Gilbert Arc Lamp Company, for the supply of eight arc lamps for the tramway standards at £112 16s.

Gravesend.—The T.C. has placed with Messrs. Ferranti, Limited, an order for 50 meters of assorted sizes.

Hampstead.—The B.C. has accepted the tender of Messrs. Thos. Parker, Limited, for the supply of a dynamo at a cost of £760.

Kinfauns Castle, N.B.—The following tenders have been received for the supplying and erecting of an electric lighting plant at Kinfauns Castle, N.B., to the specification of the consulting engineer, Mr. Morgan Williams, M.Inst.C.E.:—

Ernest Scott & Mountain			£2,360 10 0
Middleton & Townsend, Edinburgh	(a)		2,295 3 6
	(b)		2,190 0 0
Macaulay, Clarke & Maclaren, Glasgow	(a)		2,090 15 0
	(b)		2,040 15 0
	(c)		2,020 15 0
	(d)		2,036 15 0
Lowdon Bros. & Co.	(a)		2,058 19 6
	(b)		2,008 19 6
Mavor & Coulson	(a)		2,079 5 0
	(b)	(Accepted)	1,939 5 0

It is interesting to note how remarkably close the prices are for this contract as compared with the ordinary run of such tenders. The total difference between the highest and lowest is only about £400.

Middlewich.—The Electrolytic Alkali Company have given a duplicate order for two sets of double commutator machines, each wound for 2,500 amps. 250 H.P., to Messrs. Bruce Peebles and Co., who have also received a contract from the Brighton Corporation for a reversible booster at £992.

Monmouth.—The T.C. has accepted the tender of Messrs. Davey, Paxman & Co., for the supply of a boiler for the generating station at £398.

Newcastle-on-Tyne.—The T.C. has accepted the tender of Messrs. W. A. Potts & Co., of Manchester, for the supply of rails for the electric tramways extension to Walker.

Newport (Mon.).—The Electricity Committee recommended the following tenders for acceptance at Tuesday's meeting:—

Construction of tramways: Messrs. A. Krauss & Son, Bristol, £33,735.
Rails, 1,250 tons, fishplates, 40 tons: Messrs. P. & W. McLellan, Limited, Glasgow, £7,817.
Tin bars, washers, nuts, bolts and springs: Messrs. Askham, Bros. & Wilson, Limited, £837.
Lay outs of manganese steel: Messrs. Hadfields Steel Foundry Company, Limited, £350.
Track work in the car shed yard: Messrs. Hadfields, £485.
Messrs. The Cooper Patent Anchor Rail Joint Company, Limited, Leeds 2,250 anchor sole plates, £1,321 17s. 6d.
Two boosters for new power station: Chloride Storage Syndicate, Limited, £1,302 16s.
Extensions to switchboard for generating station: Britannia Company, Limited, £344 8s. 6d.

The Corporation has also accepted the tender of the E.P.S. Company for a 1,000 ampere-hour storage battery at £1,697, and that of Messrs. Mather & Platt for a balancing machine at £96.

Salford.—The T.C. has accepted the following tenders:—Walter Scott & Co., Limited, for 1,450 tons of tramrails at £6 17s. 6d. per ton, fish and sole plates at £8 7s. 6d. per ton; Cowans, Limited, fixing complete Andrews's patent duplicate mains system at £76, free from royalty; Messrs. G. Hill & Co., Manchester, for electric wiring at the new offices in Blackfriars Street, £93.

Southampton.—Babcock & Wilcox are to supply a new boiler at the electricity works at £850.

Stockton-on-Tees.—The tender of Messrs. Worth, Mackenzie & Co., of Stockton-on-Tees, for the supply of a condensing and cooling plant at the Corporation Electric Light Works, for £2,096, has been accepted. The lowest tender was £175 below, but it was thought that it would be cheaper in the long run to give the order to a local firm.

Warrington.—The B. T. H. Co. is to supply 11 cars to the T.C. for £5,966.

NOTES.

Electricity and Optics.—M. d'Arsonval, of the French Academy of Science, has brought before the attention of that Institute the experiments of Dr. Billinkin, of Epernay, and the numerous observations of the latter regarding the treatment of certain affections of the eyes by electric current at high pressure. The results, in cases of ophtalmia, were particularly surprising.

"Living London."—Part No. 21 of George R. Sims' most attractive and interesting publication (Cassell & Co, Limited, 7d. net), has an article by Desmond Young on "Lighting London." The accompanying pictures include interior views at the stations of the London Electric Supply Corporation and the South Metropolitan Gas Company.

Crystal Palace School of Practical Engineering.—On Friday, August 8th, the certificates awarded were distributed by Dr. T. Kirk Rose, F.C.S., Assistant Assayer to the Royal Mint, in the unavoidable absence of Sir William Chandler Roberts-Austen.

Electricity and Art.—According to the *Birmingham Weekly Post*, Prof. Frankland has reported to the Museum and School of Art Committee that the incandescent gas installation in the Art Gallery is to be preferred to the arc lamps, which are much less effective in promoting ventilation, and that although these (arc) lamps do not give rise to sulphur compounds, they do generate ozone and oxides of nitrogen, which are calculated to act prejudicially on the pictures. This is the first time that we have seen the heat and sulphurous fumes of gas preferred to the coolness and purity of electricity. Surely the Professor has been misled. No doubt small quantities of ozone are given off by the arc, but the amount evolved cannot "hold a candle," so to speak, to the steady and voluminous output of hot foul gases from the gas burner.

To Those Whom it may Concern.—To fully appreciate the present status of the electrical industry in Germany and methods of German finance, we commend to the notice of our readers a careful perusal of the article, "The German Electrical Industry," on p. 284 of this issue. It is a thousand pities that men like Mr. J. W. Swan and Prof. Fleming do not wholly devote their real abilities to science, and leave financial matters, with which they can have no special acquaintance, to others better able to speak with authority. The English engineers, too, who have so persistently and for so long insisted upon the claims of polyphase working, will be encouraged in their further efforts by the results obtained in San Francisco, full particulars of which we give on p. 267.

Specifications for Steel.—Some time ago we referred at considerable length to the suggested standard specifications for steel, as proposed by the American Section of the International Association for Testing Materials. Some of these have now been brought prominently before the American Society of Mechanical Engineers. Though the specifications were adopted in June, 1901, as standards, no attempt has been made to put them into force. We see no reason why they should not become general, and should like to see them considered by the Committee on Standards. The mischievous allowance of 0·10 of phosphorus hitherto common in American practice has been modified to lower and safer amounts in most cases, though still allowed in low carbon soft steel. The abstract before us does not include rails. Many American rails have come over here in unfair competition with English rails. If consulting engineers will purchase American rails containing 0·10 of phosphorus, it is not less than dishonest to call for English rails with a less amount. English railways have been singularly free from broken rails, very largely because of the excellence of the steel. For grooved tramway rails carried on a continuous concrete foundation and avoiding all bending stress we do not claim that phosphorus need be eliminated to so low a degree as with rails that are only supported at intervals. The tramway rail is rather to be purchased for its top table wearing quality than for strength as a girder, but there ought to be allowed the same latitude to the home manufacturer as is allowed to the foreigner. The curious persistence with which preference is given to foreign goods manufactured to less stringent specifications must infallibly give rise to doubts as to the relations subsisting between the engineers and the foreign manufacturers favoured by them. Ordinary castings are tied down to a maximum of 0·40 of carbon and 0·08 of phosphorus. Tested castings are to be limited to 0·05 of phosphorus, and the same of sulphur. Three classes of castings are scheduled, viz, "hard," "medium," and "soft," with varying compositions as follows:—

	H.	M.	S.
Tensile strength per sq. in. ...	85,000 lbs.	70,000 lbs.	60,000 lbs.
Yield point	38,250	31,500	27,000
Elongation in 2 in. per cent. ...	15	18	22
Contraction of area	20	25	30

Specimens 1 in. × ½ in. bent round a 1-in. circle through 120° for soft and 90° for medium castings must not fracture on outside of bent portion, and there must be no porosity on parts whose strength would thereby be impaired. We have lately seen several very doubtful clauses in specifications, and it is high time the subject was brought to standard, or the old note-books of some engineers burned. Why do not the steel manufacturers themselves do something to settle the question and suggest standard specifications?

The Formation Temperature of Calcium Carbide.—Rothmund has recently published some interesting experiments on the preparation of calcium carbide which deal principally with the temperature of formation of that substance. As most ordinary types of electric furnace tend to yield irregular temperatures, and are not very amenable to control, the work was carried out in a special apparatus constructed on the lines of the Deville furnace. It consisted of a plain carbon tube, made by drilling out an arc electrode, the raw materials being placed in "boats" of smaller, similarly prepared tube about 6 or 8 cm. long. The temperatures were estimated by measuring the radiation, using some approximate figures given by Lummer and Pringsheim, according to which 1 sq. mm. of dark rays emits 0·0042 Hefner units at 1,176° C., 0·022 at 1,324° C, and 0·064 at 1,434° C. The result of the first series of tests is shown in the annexed table, the duration of the experiment being quoted as from the time at which the furnace had attained the desired heat and the materials were introduced:—

Time of expt.	Mean amperage.	Hefner units per 1 sq. mm.	Result.
15 min.	143	0·61	Carbide.
15 „	130	0·16	No carbide.
15 „	135	0·35	Carbide.
40 „	118	0·24	No carbide.

The last test was continued for an extra length of time in order to see whether a low temperature simply rendered the formation of carbide slower; but it proves that there is a critical temperature—probably at about 0·3 Hefner units per sq. mm., or 1,620° C.—below which calcium carbide is not produced. Owing to the construction of the furnace employed, carbon was always in excess during these experiments, and metallic calcium could not have been liberated; the reaction must therefore always have followed the equation $CaO + 3C = CaC_2 + CO$. Accordingly the temperature of formation of calcium carbide is the temperature at which the dissociation pressure is equal to the partial pressure of the carbon monoxide when the latter is in equilibrium with the air and the carbon. Since no noteworthy dissociation of carbon monoxide itself occurs even at these high temperatures, this partial pressure is ¼th of an atmosphere. Thus the formation of carbide should be a reversible operation, and the substance should be reconverted into lime and carbon by the action of carbon monoxide below the critical temperature. Experiment has shown this to be true: when moderate sized lumps of commercial carbide were tested at just below the critical point, the surface changed completely in appearance, and was covered with carbon dust. In water the lumps still evolved acetylene; but it was easy to see that the gas came from the interior. When the lumps were powdered, and were heated for 25 minutes with a current of 175 amperes to a temperature corresponding with 0·34 Hefner units—*i.e.*, with one above the critical point—carbide was found in the residue, having either remained undecomposed or been reproduced; but when the test was repeated for only 15 minutes with 135 amperes at a temperature of 0·19 unit, or less than the critical point, there was no carbide left, only a loose porous mass of lime and carbon. It follows from what has been said that it should be possible to win carbide at a temperature below the above critical point, if the partial pressure of the carbon monoxide were sufficiently reduced by the employment of a current of some indifferent gas. To test this point, the previous experiments were repeated in a brisk current of hydrogen, the results being as follows:—

Time of exprt.	Mean amperage.	Hefner units per 1 sq. mm.	Result.
25 min.	236	0·27	Carbide.
30 „	242	0·21	Carbide.
35 „	268	0·12	No carbide.

The yield in the first case was copious, but the temperature reached 0·03 unit above what has already been assumed the critical point. In the second test the hydrogen has produced a distinct, though not large, lowering of the critical temperature. Probably the porosity of the carbon tube to gases is so great at the temperatures employed that it is impossible to reduce the partial pressure of the carbon monoxide below a certain point.

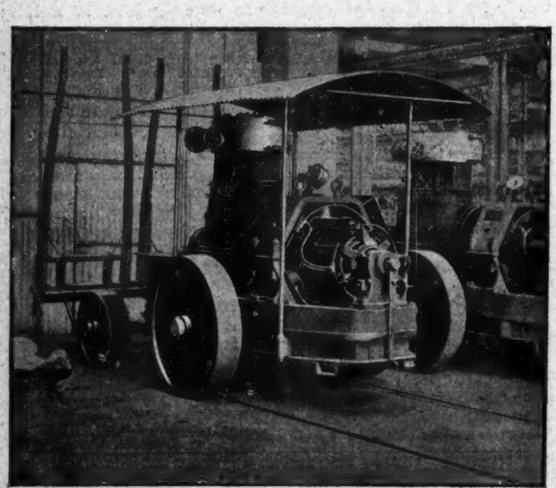
Reactions in the Manufacture of Calcium Carbide.—According to Mons. G. Gin, of Paris, free oxygen is often to be met with in the gaseous products of the electric furnace when calcium carbide is being manufactured, while vapours of metallic calcium are equally to be discovered. It is also known that more lime must be put into the charge of raw materials than corresponds chemically with the equation $CaO + 3C = CaC_2 + CO$. These facts the author explains by stating that there are several different zones in the furnace where different temperatures occur, and where different chemical reactions accordingly take place. Berthelot has already shown that carbon monoxide is completely decomposed at extremely high temperatures, being dissociated into its elements like the hydrocarbons; and similarly there must be a place in the electric furnace where it is too hot for carbon monoxide to be produced. At this spot the reaction between lime and carbon, according to Gin, is $CaO + 2C = CaC_2 + O$. This accounts for the liberation of oxygen, which may be detected at the sides of the upper electrode. Where the temperature is slightly lower, but still above that at which carbon monoxide can exist, the reaction may be expressed as $CaO + C_{n+2} = CaC_2 + CnO$; the latter body being apparently a suboxide, C_2O. In other places a sesquioxide, C_2O_3, is formed; and finally, these new oxides of carbon react with fresh quantities of lime to yield calcium carbide and carbon monoxide according to various formulæ, which combined all together equal the usual equation given above. The calcium

vapours are produced by the interaction of calcium carbide and quicklime in a manner represented by the formula $Ca C_2 + Ca O = 2 Ca + C_2 O$, if the action takes place in the portion of the furnace where the temperature is at its highest, or by $Ca C_2 + 2 Ca O = 3 Ca + 2 CO$ elsewhere. This last decomposition explains why an excess of calcium oxide is required in the manufacture of calcium carbide over that corresponding with the theoretical amount.

The British Uralite Company, Limited.—On the invitation of the directors of this company a number of Press representatives visited the company's works at Higham, Kent, on Wednesday last, to investigate the wonderful properties of uralite, an absolutely trustworthy fire-resisting material, to the applications of which substance there appears to be practically no limit. Want of space compels us to defer publication of particulars till next week, but we may say here that our readers will find much to interest them in what we shall have to say.

Coronation Illuminations.—The Glasgow Tramways Department illuminated Renfield Street with over 500 celluloid balloons of various colours lit up with electric lamps and fixed to the overhead guard wires. The same department also ran for three nights over the whole system three illuminated cars, suitably decorated. The lighting department had their power station at Port Dundas illuminated, and used a searchlight on the roof of the tower at the works. They also had the municipal buildings illuminated with Flame arc lamps spread over the west front of the buildings. All the electrical effects were much appreciated.

Portable Lighting Machinery for Portsmouth Dockyard.—To meet the need of an electric light plant which can be readily transported from place to place on military or naval service, the portable generating sets shown in the accompanying illustration has been designed and manufactured by Messrs. W. H. Allen, Son & Co., Ltd., of Bedford. As will be seen, the plant consists of one of this firm's high speed enclosed compound forced lubrication engines, directly coupled to a six-pole dynamo of the same firm's manufacture, and mounted on a transporting carriage. The combination is capable of giving an output of 105 volts 600 amperes when running at a speed of 400 revolutions per minute, steam being supplied at a pressure of 110 lbs. on the square inch at the engine stop-valve. The particular plant shown is one of several which have been constructed by Messrs. Allen for the temporary lighting of any part of H.M. Dockyards; it is intended to be drawn by horses, the carriage being rigidly built, and mounted on four wheels with broad treads and substantial axles, the whole being sufficiently stable to enable the plant to be transported over rough ground without injury to any part. The base-plate of the engine and dynamo is arranged so that it can be lifted off the carriage and bolted down on a fixed foundation if required. The carriage is covered with a roofing of galvanised corrugated iron, with waterproof curtains hanging from rails on the sides and ends. Boxes fitted with waterproof lids, with padlocks and keys, are provided for stowing tools, spare parts, and stores. The weight of the complete plant is 8 tons 19 cwts. One of these sets was lately fitted on board the Royal Yacht, *Victoria and Albert*. It was found that the engines and dynamos which were already there created too much vibration, and

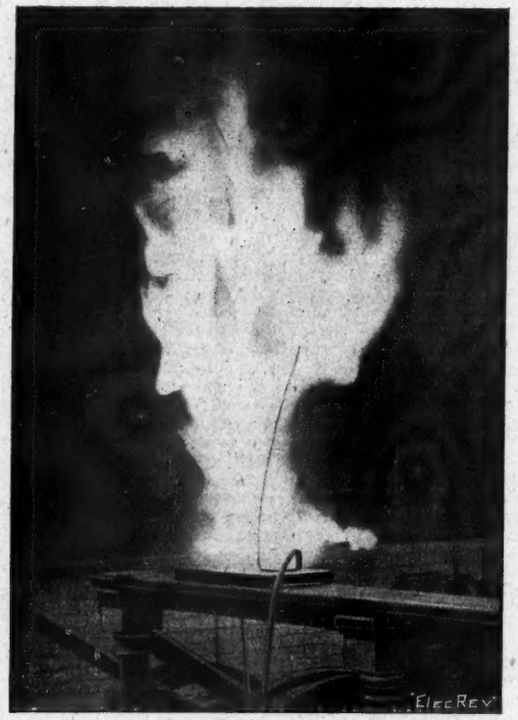


Portable Steam Dynamo.

as the plant we illustrate is a silent working engine, it was decided to fit this type on the yacht. The work was undertaken and completed in less than seven days, which is a record for the large amount of work necessary. The trials took place on Sunday, July 13th, and it was gratifying to find that with the engine working at full load, and delivering 60 kw., not a sound could be heard in the Royal apartments. Stringent tests were made by the dockyard and other authorities to ascertain the vibration, and bowls of water were placed in various parts of the ship, but not a trace of vibration could be detected.

Appointments Vacant.—Fitters with electrical knowledge, and efficient wiremen are wanted for H.M. Dockyard at Chatham; an assistant is required at Ilkeston at £110 per annum; an assistant engineer for Taunton electricity works at £100. An engineer is wanted to assist in preparing a large lighting, power, and traction scheme for the Colonies.

A 5,000-volt Arc.—The accompanying photograph, which was taken at the Croydon electricity works, shows a high pressure arc, which was "rigged up" on the occasion of a visit to the works. The arc was formed at the bottom of two copper rods



A 5,000-Volt Arc.

and rose gradually to the top, where it assumed various fantastic shapes, and finally broke. As the photographic plate was exposed during the whole time, the successive positions of the arc are merged into one another. The area thus covered by it was 4 ft. high by 2 ft. wide.

Newcastle Tramways.—In the article on the above tramway system, concluded in our issue of August 1st, omission was made to mention the fact that practically the whole of the rolling stock was equipped with motors and controllers by the British Thomson-Houston Company, Limited. The motors were of their well-known GE 58 type, and numbered 140.

Personal.—Mr. Wm. Clark, the chief engineer of the Glasgow Tramways, has just received the appointment as general manager of the Lisbon Tramways at a salary of £1,500 per annum. He has been in the Corporation service since 1885. Mr. Clark looked more after the mechanical work of the tramways, Mr. Field being the chief electrical engineer.

Mr. W. C. S. Phillips has been appointed assistant lecturer and demonstrator for electrical engineering at the Borough Technical Institute at Derby.

Mr. H. Bohle, of Birmingham, has been appointed lecturer in electrical engineering to the Bradford Municipal Technical College.

Mr. Arthur E. Hadley has resigned his seat on the board of the Ferranti Company, and has taken the position of manager to the Allgemeine Electric Company, London.

Taff Vale Railway and Electricity.—At Tuesday's meeting of this railway company it was stated that the directors are closely watching what other railways are doing in regard to electric traction.

THE CENTRAL STATION ENGINEER.

The staff of the Windsor Electric Light Company, 50 in number, went for their annual outing on 1st inst., taking a trip by steam launch to Marlow.

The Ilford electricity department staff went to Hoddesdon, Herts, for their first annual outing on 2nd inst.

Mr. A. Pickersgill, assistant at Dewsbury, has been appointed electrical engineer at Cleckheaton at a salary of £200 per annum.

At the monthly meeting of Wigan County Borough Council last week, a recommendation of the Electric Light and Tramways Committee, that Mr. JAMES SLEVIN be appointed electrical engineer of the borough, was confirmed.

Mr. J. R. P. LUNN, borough electrical engineer at Darlington, is not prepared to accept the condition imposed on his salary being increased by £50 a year that he should stay with the Corporation for three years, and on August 7th the T.C. referred the matter back to the Electric Lighting and Tramways Committee for further consideration.

Mr. P. P. WHEELWRIGHT, mains superintendent of the Blackburn Corporation Electricity Works, has been appointed chief assistant electrical engineer at a salary of £175 a year.

NEW COMPANIES REGISTERED.

South Yorkshire Promoters, Limited (74,476).—This company was registered on July 26th, with a capital of £99 in £1 shares, to carry on the business of an electric light and power supply company, and the business of electricians, electrical, metallurgical and general engineers, &c., in the West Riding of Yorkshire or elsewhere. The first subscribers (each with one share) are:—A. Etchells, Cedar Grove, Heaton Moor, near Stockport, engineer; W. Bayliss, The Grove, Currier Lane, Ashton-under-Lyne, engineer; H. Eckersall, 9, Crescent Road, Birkdale, manager; J. B. Hyde, 33, Stamford Street, Old Trafford, Manchester, engineer; C. K. Hamilton, 8, Windsor Terrace, Old Trafford, Manchester, manager; P. A. Ramage, 10, Gardner Road, Prestwich, engineer; and R. V. Milner, Torwood, Westmorland Road, Southport, cashier. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first. Registered office, 78, King Street, Manchester.

South American Light and Power Co., Ltd. (74,446).—This company was registered on July 24th, with a capital of £100,000 in £1 shares to carry on in the Argentine Republic or elsewhere in America or any other part of the world the business of electrical, gas and general engineers, suppliers of electricity, gas, and electric or gas light, heat and power, contractors for, manufacturers of, and dealers in plant, machinery, appliances and things used in connection with the supply and use of electricity, gas, heat and power for lighting, traction, the transmission of sound or power or of electric signals, the application of electricity to metal work or otherwise, and to adopt an agreement with C. R. Thursby. The first subscribers (each with one share) are:—C. R. Thursby, 60, Curzon Street, W., civil engineer; C. M. Wilkins, 30, Coleman Street, E.C., solicitor; J. Young, 26, Chapter Road, Willesden Green, N.W., secretary; E. T. A. Phillips, Hurstwood, Bromley, Kent, gentleman; R. D. Hoyle, 12, Linden Mansions, Highgate, N., solicitor; E. Meltborpe, 97, High Street, Mortlake, accountant; and W. W. Hargrove, 99, Cannon Street, E.C., solicitor. No initial public issue. The number of directors is not to be less than two nor more than seven; the first are C. R. Thursby, C. M. Wilkins and J. Young; qualification, £300; remuneration, £50 each per annum. Registered office, 37, Lombard Street, E.C.

Southern Counties Monorail Syndicate, Limited (74,430).—This company was registered on July 23rd, with a capital of £50,025 in 500 ordinary shares of £100 each and 500 deferred shares of 1s. each, to construct, equip, work, maintain, improve and operate any railways on the "monorail" or other system, to acquire any railways or tramways which seem capable of being worked in connection with any railway in which the company is interested, and to carry on the business of railway, telephone and telegraph proprietors, manufacturers of rolling stock, carriers by land or water, warehousemen, forwarding agents, insurance agents, owners of land, house and other property, electricians, electrical, metallurgical, mechanical and general engineers, suppliers of energy for light, heat, power or otherwise, &c. The first subscribers (each with one ordinary share) are:—P. A. Sechiari, Palmerston House, E.C., gentleman; A. Grove, J.P., Berydown Court, Overton, Hants.; G. E. Raine, 46, Stratford Road, Kensington, W., barrister; W. J. Fraser, 33, Brunswick Square, Brighton, solicitor; N. B. W. Brady, 7, St. Helen's Place, E.C., solicitor; A. S. Chetwood, Sun Street, Waltham Abbey, Essex, solicitor; and S. A. Henley, 132, Brownhill Road, Catford, S.E., secretary. No initial public issue. The number of directors is not to be less than three nor more than nine; the first are P. A. Sechiari, A. Grove, J.P., G. E. Raine, W. J. Fraser, and N. P. W. Brady, with power to add to their number. Registered office, 7, St. Helen's Place, E.C.

East India Tramways Company, Limited (74,457).—This company was registered on July 25th, with a capital of £80,000 in £1 shares, to construct and work tramways, railways, and property in India, including the tramways undertaking, concessions, lands, buildings and property of the East India Tramways Company, Limited (in liquidation), to equip, maintain, and work by electric, steam, horse or other power any of the company's tramways or railways, and to carry on the general business of tramway, railway, omnibus and van proprietors, carriers of passengers and goods, manufacturers of, and dealers in, locomotives, rolling stock, accumulators, dynamos and accessories, suppliers of electricity for light, heat, or power, or for telephonic, industrial, or other purposes, &c. The first subscribers (each with one share) are:—J. Abbott, Mirasol, Eastbourne; H. D. Kimber, 79, Lombard Street, E.C., solicitor; T. Boatman, 79, Lombard Street, E.C., solicitor; G. Gale, 7, Highgate Road, N.W., accountant; E. P. Williams, 31, Elgin Crescent, Notting Hill, W., solicitor; W. W. Lovett, 50, Woodville Road, Thornton Heath, clerk; and A. H. Gray, 93, Shepherdess Walk, N., clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration, £300 per annum, divisible.

Burmah Tramways Construction Company, Limited (74,555). This company was registered on July 25th, with a capital of £50,000 in £10 shares, to construct, equip and work (as owners, lessees or contractors) railways, tramways, light railways, roads, undertakings for the generation, supply or distribution of electric or other power, either for purposes of locomotion, for the working of plant or machinery or for telegraphic or telephonic purposes or otherwise, and any other works and conveniences which may be calculated to turn to profitable account any right or assets of the company, and to adopt an agreement with Woolston Beeton Brodrick and West and others. The first subscribers (each with one share) are:—F. Mott, 118, Brixton Hill, S.W., secretary; C. Bassett, 118, Godolphin Road, Shepherd's Bush, W., clerk; T. W. Calvert, 54, Gloucester Road, South Tottenham, clerk; I. A. J. Smith, 78, Glengarry Road, S.E., clerk; G. J. Smith, 2, Grosvenor Terrace, Station Road, Sidcup, clerk; W. Nicholls, 31, Melgund Road, Highbury, N., clerk; and A. E. Noakes, 2, Fowler Road, Forest Gate, clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; remuneration as fixed by the company.

New Gutta-Percha Company, Ltd. (74,517).—This company was registered on July 30th, with a capital of £200,000 in £1 shares, to adopt an agreement with H. Woolner, R. S. Jones, and S. Bibby, to manufacture, buy, sell, refine, prepare, mix, grow, import, export, and deal in india-rubber, gutta-percha, balata, and other gums, substances and materials connected therewith, or any substitutes therefor, and to carry on any business incidental or auxiliary to the above objects. The first subscribers (each with one share), are:—R. S. Jones, 4, Copthall Chambers, E.C., stockbroker; S. Bibby, Dashwood House, E.C., accountant; A. E. Debin, Mynehurst, Stanmore Road, Richmond, Surrey, gentleman; H. L. Clayden, 89, Upper Baker Street, N.W., gentleman; H. P. Gibbons, Marwood, Crutchfield Road, Walton-on-Thames, gentleman; A. Cooper, 52a, Croom's Hill, Greenwich, gentleman; and J. R. Jarvis, 2, Normand Mansions, Normand Road, West Kensington, gentleman. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £1,000; remuneration, £300 per annum for the Chairman, and £200 each for the others. Registered office, Dashwood House, New Broad Street, E.C.

Newton-Pearce Motor Car Company, Limited (74,545).—This company was registered on August 1st, with a capital of £10,000 in £1 shares, to adopt two agreements (1) with G. E. Heyl-Dia, C. H. Stocks and H. Pearce, and (2) with G. E. Heyl-Dia, to acquire a license to use a certain patent process for variable throttle, cut-off or expansion cam gear, and to carry on the business of motor car and vehicle manufacturers in all its branches. The first subscribers are:—C. H. Stocks, 213, Deansgate, Manchester, 2,000 shares; H. Pearce, Hulme Hall Road, Manchester, 2,000 shares; T. A. Daw, 151, Church Street, Pendleton, 1 share; H. De A. Humphrey, Hulme Hall Road, Manchester, engineer, 1 share; G. E. Heyl-Dia, 236, Great Clewes Street, Manchester, electrical engineer, 2,000 shares; A. W. Medley, Huyton, near Liverpool, department manager, 1 share; and A. F. Stevenson, 22, Arpley Street, Warrington, electrical engineer, 1 share. No initial public issue. The number of directors is not to be less than two nor more than five; the first are G. E. Heyl-Dia (chairman), C. H. Stocks and H. Pearce; qualification, £500. Registered office, 55, Market Street, Manchester.

Peterborough Electric Traction Company, Limited (74,562).—This company was registered on August 5th, with a capital of £60,000 in £5 shares, to carry on the business of carriers of passengers and goods, electrical and general engineers, contractors, electricians, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, generators, accumulators, transmitters, users and suppliers of light, heat, sound and power by electricity, galvanism, magnetism, compressed air, gas, steam, oil, or otherwise, railway, tramway, and shipway owners, promoters, financiers, &c. The first subscribers (each with one share) are:—Lord Vaux of Harrowden, Harrowden Hall, Wellingborough; E. Garcke, Donington House, Norfolk Street, W.C., managing director; W. J. Greer, 58, South Eaton Place, S.W., director; T. E. A. Baker, 19, Oxford Terrace, W., solicitor; B. Kingsford, 77, Queen's Road, Wimbledon, secretary; F. C. Cocking, 69, Friern Road, East Dulwich, registrar; and C. H. Godward, 158, Park Road, Crouch End, N., secretary. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; remuneration, £50 each per annum and a share in the distributed profits divisible. Registered office, Donington House, Norfolk Street, W.C.

Electrical Automatic Loom Syndicate, Limited (74,540).—This company was registered on August 1st, with a capital of £60,200 in 60,000 preference shares of £1 each and 4,000 deferred shares of 1s. each, to acquire and turn to account any patents, inventions, concessions and the like relating to the automatic changing of shuttles or to the automatic indication of breakage in weft or warp, or to other devices for the better working of looms, or otherwise, to adopt an agreement between the Electrical Machinery Developments Company, Limited, of the first part, E. Zappert of the second part, L. Rendell and A. C. Bird of the third part, and A. C. Wallace (for the company) of the fourth part; and to carry on the business of weavers, manufacturers of and dealers in looms and other machinery, financiers, &c. The first subscribers are:—E. J. Haggar, 18, Ferron Road, Clapton, N.E., accountant, with one preference share; A. C. Wallace, 26, The Mansions, Richmond Road, Earl's Court, W., accountant, with one preference share; T. H. Jones, 14, Ainsworth Road, Croydon, clerk, with one preference share; C. S. Keeble, 27, Hoames Street, Denmark Park, S.E., engineer's assistant, with one preference share; W. E. Hopper, 118, Akerman Road, Brixton, S.E., secretary, with one preference share; W. G. Thomas, 120, Palewell Park, East Sheen, Surrey, accountant, with 100 deferred shares; and The Electrical Machinery Development Company, Limited, 151, Cannon Street, E.C. (per E. J. Haggar, director), with 3,900 deferred shares. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first, subject to E. Zappert's right to nominate one; qualification, £500; remuneration, £150 each per annum; registered office, 151, Cannon Street, E.C.

North British Electrical Company, Limited (74,532).—This company was registered on July 31st, with a capital of £10,000 in £1 shares, to adopt an agreement with the Electrical Maintenance and Accessories Syndicate, Limited, and Gilchrist & Co., and to carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electrical, magnetic, telegraphic, telephonic, and other appliances, &c. The first subscribers (each with one share) are:—C. Cowley, Springfield, High Street, Chorlton-on-Medlock, secretary; W. J. Cowley, 251, Upper Brook Street, Chorlton-on-Medlock, traveller; S. Smith, 90, Roby Street, Moss Side, Manchester, clerk; W. H. Gatley, 44, Acomb Street, Chorlton-on-Medlock, manager; H. T. Holliman, 31, Langworthy Road, South Salford, secretary; T. H. Rutter, 26, Quay Street, Manchester, theatre assistant manager; and F. W. Hatton, 84, Cornbrook Street, Old Trafford, Manchester, designer. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £50; remuneration as fixed by the company. Registered office, 205—7, Deansgate, Manchester.

Wireless Control Syndicate, Limited (74,584).—This company was registered on August 7th, with a capital of £20,000 in £1 shares, to adopt an agreement with R. Steele and to carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power and otherwise, manufacturers of and dealers in electrical appliances and apparatus used in the electric control of mechanical operations at a distance without wires or other tangible connections, &c. The first subscribers (each with one share) are:—H. G. Rastall, Salisbury House, E.C., solicitor; S. G. Ball, 6, Princess Road, Regent's Park, N.W., clerk; J. Steele, 24, Billiter Street, E.C., ship-broker; E. Mason, 6, Gracechurch Street, E.C., clerk; E. R. Welsh, 22, Billiter Street, E.C., clerk; A. J. Greenop, Bush Lane House, Cannon Street, E.C., solicitor; and E. H. Neville, 15, Geneva Road, Brixton, S.W., clerk. Minimum cash subscription £5,000. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company.

Peter Pilkington, Limited (74,585).—This company was registered on August 8th, with a capital of £30,000 in £10 shares, to acquire the business now carried on by W. R. Pilkington, trading as P. Pilkington, as Dowry Works, Accrington, Lancs., to adopt an agreement between W. R. Pilkington of the first part, J. Pilkington of the second part, and G. W. Grimshaw of the third part, and to carry on the business of manufacturers of power hammers, steam hammers, forges and forging machinery and plant, mine and mining machinery, mechanical and electrical engineers, metal founders, &c. The first subscribers (each with one share) are:—W. R. Pilkington, 123, St. John's Terrace, Accrington, engineer; J. Pilkington, 22, Burnley Road, Accrington, engineer; G. W. Grimshaw, Glengarry, Lytham, gentleman; H. Whitcombe, 11, Lord Street West, Southport, bolt manufacturer; A. A. Gatty, Bannister Hall, near Preston, dyer; M. Diggle, 14, Park Road, Lytham, engineer; and L. L. Sprake, 10, Burnley Road, Accrington, solicitor. No initial public issue. The directors are W. R. Pilkington, J. Pilkington and G. W. Grimshaw; qualification of first directors not specified; of subsequent directors, £1,000; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Evered & Co., Limited (20,158).—This company's annual return was filed on June 10th, when the entire capital of £300,000 in 20,000 shares of £10 each had been taken up. £10 has been called up on 8,504, and £7 on 6,880 shares, resulting in the receipt of £79,700. £91,044 is considered as paid, being £10 per share on 6,744, and £7 per share on 8,972. Mortgages and charges, £50,000.

Electric and General Investment Company, Limited (31,506).—This company's annual return was filed on July 19th, when the entire capital of £200,000 in 20,000 ordinary, 100 founders and 19,900 preference shares of £5 each had been taken up. £1 has been called up on 20,000 ordinary, and £5 on 100 founders and 19,900 preference shares, resulting in the receipt of £120,000. No mortgages or charges.

West African Telegraph Company, Limited (21,626).—This company's annual return was filed on July 22nd, when 23,109 shares were taken up out of a nominal capital of £400,000 in 40,000 shares of £10 each. £10 has been called up on each share, resulting in the receipt of £231,090. Mortgages and charges, £139,300.

United River Plate Telephone Company, Limited (23,654).—This company's annual return was filed on July 28th, when 5[illegible],000 ordinary and 40,000 preference shares were taken up out of a nominal capital of £500,000 in 60,000 ordinary and 40,000 preference shares of £5 each; £5 has been called up on 42,000 ordinary and 40,000 preference shares, resulting in the receipt of £410,000. £80,000 considered as paid on 16,000 ordinary shares. Mortgages and charges, £179,947.

W. T. Henley's Telegraph Company, Limited (13,795).—This company's annual return was filed on July 11th, when 35,000 preference and 35,000 ordinary shares were taken up out of a nominal capital of £400,000 in 40,000 preference and 40,000 ordinary shares of £5 each: £5 has been called up on 35,000 preference and 29,000 ordinary shares, resulting in the receipt of £320,000. £30,000 considered as paid on 6,000 ordinary shares. Mortgages and charges, £48,850, being £50,000, less £1,950 transferred to trustees.

Calcutta Tramways Company, Limited (14,764.)—This company's annual return was filed on June 18th, when 84,440 shares were taken up out of a nominal capital of £350,000 in 35,000 shares of £10 each; 5,350 shares are issued subject to payment wholly in cash; £159,300 has been received, and £185,100 is considered as paid on 29,090 shares. Mortgages and charges, £350,000. A resolution sub-dividing each £10 share into two shares of £5 each, was passed on May 26th, and confirmed on June 23rd. Capital increased to £525,000 in June 1902; 31,860 £5 shares allotted subsequently to date to which returns were made up.

REVIEWS.

Pipes and Tubes. By P. R. Björling. London: Whittaker & Co. 1902. Price 3s. 6d.

For those who have to deal with pipes, there is a wonderful amount of information in this book. Beginning with general rules relating to the flow of water, air, and steam in pipes, the author proceeds to discuss, with an abundance of illustrations, the various types of joints in use for wood, cast-iron, wrought-iron, and other kinds of pipe. Lead and earthenware pipes are also dealt with, as well as a variety of ball-and-socket and swivel joints. Next, the question of corrosion in water pipes is taken up, followed by a chapter on testing pipes.

The actual process of laying and jointing pipes in place is briefly explained, with the apparatus required, and the book concludes with a large number of tables for use in pipework.

The treatment of steam piping is very meagre; the bulk of the work is devoted to water pipes, which are dealt with in great detail.

Elementary Electricity and Magnetism. By D. C. Jackson and J. P. Jackson. New York: Macmillan & Co., Ltd. 1902. Price 7s. 6d.

This is a handsomely bound, well illustrated text-book, designed for students and readers with a taste for science. The order of the book is intended to be from simple to complex, "an overthrow of the traditional academic order," and "the substitution therefor of a rational presentation of applied science."

We find that, as from the earliest days, the volume commences with frictional electricity, "vitreous or positive," and "resinous or negative," and deals with electric potential, glass plate machines, &c., before reaching primary batteries; then come chapters on electrolysis and magnetism. But that this is *not* the best sequence was fully demonstrated years ago by Prof. Ayrton, and recognised by Dr. John Hopkinson, Prof. Thompson, and others at a later date. Although Prof. Thompson's ever-popular classic "Elementary Lessons" (upon which the book under consideration would seem to have been modelled), begins in a somewhat similar order, that is merely because it is a classic; for many years his lecture courses have commenced with consideration of electric currents—surely the most rational and practical order. Because "frictional" electricity was first observed, is that any reason why it should *always* be first considered? We know that the vertebrate embryo, in its early development, passes through stages, the evolution of which has occupied countless ages, but there is not the slightest necessity to conduct the budding electrician through a similar course. However, the authors have confined this introduction to 80 pages—and one can always skip.

Arriving at that grand foundation upon which all electrical engineering is based—Ohm's law—we find it stated not as Ohm enunciated it, but in the form $C = \frac{E}{R}$. Seeing that the essence of the law is conveyed by this expression, it is only a quibble, and savours somewhat of that embryonic evolution to which we have objected, to insist, as some do, upon the original form $E \div C =$ a constant. The operation of the law is illustrated by hydraulic analogues, but these take the form of pipe systems, which will convey but a feeble impression to the average student—too much imagination is called for.

From this point the book becomes thoroughly practical; electro-magnetism, upon which hinges the whole industry, and the phenomena of electro-magnetic induction, are dealt with in a clear and concise manner, and are followed by measuring apparatus and methods. It is somewhat unfortunate that the reflecting galvanometer is not duly credited to Lord Kelvin, though the moving-coil galvanometer, which he used long before d'Arsonval, is attributed to the latter. Weakly yielding to common but improper usage, the authors permit the title of "recording wattmeter" to be applied to instruments which cannot record watts. Next come dynamos and motors, alternators, &c., more than half the book being devoted to this subject, and to the practical applications of electricity, which are admirably dealt with. Apparently every important branch of electrical industry is touched upon, including wireless telegraphy and X rays. Naturally, the sections on electric lighting and traction, and the apparatus used therein, are especially fully treated.

The book is unusually well illustrated, most of the figures being specially prepared and many of them representing up-to-date appliances, power plant, &c. Amongst the diagrams we recognise some re-drawn from figures in well-known books by Profs. Thompson and Jamieson, the use of which might have been acknowledged.

In conclusion, we have formed a high opinion of the usefulness of the book, and can readily recommend it to beginners in electrical engineering.

CITY NOTES.

Hong Kong Electric Company.

The report of the manager, Mr. W. H. Wickham, dated June 18th, states that the lamps and fans connected to the company's incandescent lighting service on June 1st were equivalent to about 16,300 lamps of 8 c.p. The number of arc lamps now in operation is 85. The number of lifts operated by the power service has been increased to nine. During the year the three original incandescent lighting sets, laid down in 1890, have been discarded, and a steam alternator of much larger capacity has been erected in the space thus rendered available. A duplicate steam alternator for working the day load has also been recently received, and is now in process of erection.

The directors' report for the year ending April 30th, 1902, shows that the balance at credit of profit and loss account is $65,737.96. After deducting directors' fees ($3,000), there remains the sum of $62,737.96 available for appropriation. It was proposed to pay a dividend of 8 per cent., which absorbed $36,000.00, to write off plant account for depreciation, $25,462.57, and to carry forward to next account $1,275.39.

Baker Street and Waterloo Railway.

The ordinary half-yearly meeting of the proprietors of this company was held on Thursday of last week at Hamilton House, Victoria Embankment, W.C., Mr. Theodore Julius Hare presiding.

In proposing the adoption of the report, the Chairman said during the half-year the sum of £66,011 had been spent on capital account, and of this £42,590 was spent in the last three months of the half-year. It would be remembered that the transfer of the construction contracts to the Metropolitan District Electric Traction Company only took place on March 7th, and some little time had to elapse before the works, which had been suspended, could be re-started; therefore, practically only three months' work was comprised in the half-year. During the current half-year the rate of expenditure would be considerably higher. The estimate up to December 31st next, including land, would be £175,000. The works were being pushed on as rapidly as possible, and satisfactory progress was being made. Between Baker Street and Waterloo there was in the double

line about six miles of single tunnel; of this only a trifle over 1½ miles remained to be constructed, so that it might be said that 75 per cent. of the tunnelling between these points was finished. At the stations the lift shafts had been completed at Waterloo, Piccadilly Circus, and Baker Street, and were about to be commenced at Oxford Circus. Staircase shafts at Waterloo and Oxford Circus had been sunk. The booking hall at Waterloo had been covered in and was ready for the external fittings. All the land for the station sites from Baker Street to the depôt in St. George's Circus had been arranged for, and the company was in possession except at Trafalgar Square, and there possession would shortly be obtained and the work started. The Metropolitan District Electric Traction Company had given notice, under the powers of their agreement with that company, that they would supply the company with electric power at a price to be agreed upon, or, failing agreement, to be settled by arbitration. The construction contracts and agreements relating thereto had now been transferred by the Metropolitan District Electric Traction Company, whose capital was £1,000,000, to the Underground Electric Railways Company, of London, with a subscribed capital of £5,000,000 sterling. The necessary legal formalities signifying that company's sanction to the transfer were in course of preparation and would shortly be completed. The advantages of the change to that company were obvious, and, as they had been informed at the last half-yearly meeting, the financiers behind the new company were of the very highest standing, and there could be no doubt that anything they undertook would be promptly and satisfactorily carried through. They had received interest on their shares up to June 30th last, including all arrears as from December 1st, 1900. The warrants were issued by that company on behalf of the contractors, who had assumed that company's liability to pay interest during construction. In future the warrants for that interest would be issued on July 15th and January 15th in respect of the half-years ending June 30th and December 31st. The company's Bill, the object of which had already been explained to the shareholders, had passed the Committees of both Houses of Parliament, but owing to its being opposed, together with several other "Tube" Bills, on third reading in the House of Commons, it could not now receive the Royal Assent until the autumn session. Several of the Tube Railway Bills promoted this session were opposed in their interests. Some of them had been rejected or withdrawn, and in others clauses for the protection of their company had been inserted.

Sir ALGERNON WEST seconded the motion, and the report was unanimously adopted.

Blackpool Electric Tramways (South).

A MEETING of debenture holders in this company, took place at the Law Association Rooms, Liverpool, on Thursday of last week. Mr. J. S. HARMOOD BANNER, who presided, stated that the trustees had the whole of the money subscribed on the debentures; some £150,000 being in the bank, to await further action. The arrangements with the Electric Tramways Construction Company, who had issued the prospectus, were not of a satisfactory character. The trustees therefore proposed a scheme by which the construction of the electric line should be proceeded with, and completed, independent of the Construction Company. A sum of £30,000 had been separately provided for the purchase of the remaining interest in the old company, and the funds then available would be ample. He proposed resolutions that the work of the scheme be proceeded with. On the proposal of Mr. Rutherford, a time limit of seven weeks for completing the new arrangements and getting to work, or, as an alternative, the taking of steps for the return of the money to the stockholders, was carried. The resolution, as amended, was adopted by 46 votes to 4.

Waterloo and City Railway.

COLONEL THE HON. H. W. CAMPBELL presided at the half-yearly meeting last week.

The CHAIRMAN, after apologising for the absence through indisposition of the chairman of the company (Sir Wyndham Portal), remarked that on the last occasion Sir Wyndham had the pleasure of announcing that they were for the first time in the happy position of being able to pay a dividend of 3 per cent. on the paid-up capital without asking the working company to make it up under the agreement. On the present occasion the accounts were still better, because, after providing for 3 per cent., there was a surplus of £504, and, as by arrangement with the working company, the accumulated deficiency in net revenue of past half-years had been disposed of, the surplus over 3 per cent. came in for division between the two companies, and this company took two-thirds, or £336. That did not enable them to pay more than 3 per cent. per annum for the past half-year, but after paying the dividend on the ordinary and debenture stock, they carried forward a good balance of £458 towards the current half-year. To pay a dividend of ¼ per cent. would require £675. Dealing with the accounts, the ordinary stock remained unchanged at £540,000. The debenture stock was more by £6,500, making the total on June 30th last £65,500. The total amount received on capital account is £605,500, and the total sum expended was £605,317, leaving a balance to the credit of that account of £182. They had received from the working company (the London and South-Western Railway) £8,191 upon an adjustment of accounts with them. They had at the same time relieved them from being called upon at any time to pay the accumulated deficiency already referred to. The arrangement did not extend to any deficiency which might arise in the future, but they had every hope that such might not happen. On the credit side of the revenue account they would see that the passenger fares, less Government duty, amounted to £16,957 as against £16,101 in the corresponding period of 1901, which showed a satisfactory increase of £856. Rents were £247, as against £214, and the total receipts of the line were therefore £17,204, as against £16,315 at June, 1901. On the other side of that account the first item was £7,714 for working expenses, or £1,200 less than a year ago, while as compared with the gross receipts, the rate was 44·84 per cent. as against 54·78 in June, 1901. The difference between the receipts of the line and the working expenses was £9,489, and as a dividend at 3 per cent. on the paid-up capital absorbed £8,985, there remained a surplus of £504, of which that company took two-thirds, or £336, and the working company one-third, or £168. General charges were £269, as against £263 a year ago, and the result was that they carried £9,060 to the net revenue account. They had paid £885 interest on debenture stock, £381 rent charge for easements at Waterloo Station, which left £8,558 available for dividend on the ordinary stock. A dividend at 3 per cent. per annum absorbed £8,100, and they carried forward £458 to the current half-year. Nearly 2¼ million passengers were carried during the past half-year, and that was exclusive of journeys made by season-ticket holders, so that if they added those they would arrive at about 2½ million for the half-year. The working company had introduced an altered system of signalling, and were thus enabled to run the trains more frequently, and he would like to say that the officers of the working company, from the general manager downwards, had spent a good deal of time, and had taken great pains to try and run the trains with the utmost expedition, while always bearing in mind the important element of safety. He concluded by proposing the adoption of the report and accounts.

Sir CHARLES SCOTTER seconded the motion, and it was carried.

Barcelona Tramways Company.

MR. J. B. CONCANNON presided at an extraordinary general meeting held at Winchester House on 6th inst., at which a resolution for the confirmation of the agreement between the company and Luis Pujol and Juan Llopart, of Barcelona was passed, whereby an option is given to purchase the company's undertaking. Mr. Concannon said that the agreement for the sale of the undertaking provided that the price should be £590,000 *plus* the value of unissued shares, cash in hand, &c., on October 31st. The purchasers would take over the undertaking on November 1st. The main point of interest to the shareholders was the effect of the sale as regarded them. The debenture and preference holders would get a fixed sum. The board estimated the return to the ordinary shareholder at about £11 10s. to £12. The city of Barcelona was very progressive, and the Spaniards who had entered into the agreement felt that the undertaking should be in the hands of their own countrymen. Some shareholders thought that a higher price should have been obtained, as the undertaking was being sold just when its prosperity was becoming thoroughly assured.

Liverpool Overhead Railway Company.

SIR WM. FORWOOD presided at the half-yearly meeting on Tuesday, and, in moving the adoption of the report, expressed the regret of the board that the gross receipts showed a diminution, as compared with the corresponding half of last year, of £3,580. This was accounted for from the fact that they had carried 356,000 fewer passengers. The decrease represented about 7 per cent. The mileage was also slightly less on account of the Dingle station having been closed for seven or eight weeks. The expenditure showed £1,391 reduction. They had put aside £1,500 to the renewal fund, which now reached the very satisfactory total of £22,300. During the half-year they had their permanent way reported on by Sir Douglas Fox, who had found no appreciable depreciation whatever in the line as compared with its condition 10 years' ago. On their locomotive power they had effected during the half-year a saving of £1,111, this being mainly due to cheaper coal. Their gross earnings amounted to £37,988, and their working expenses to £29,287. After paying interest on their mortgage debentures (£3,400) they had remaining £5,300, which along with the balance brought forward from the 1901 account and £300 over-provided for the Dingle calamity and now available for dividend, gave £9,292 odd. Of this the directors proposed to devote £3,000 to a 5 per cent. dividend on preference shares, and £2,500 to 1 per cent. on ordinary shares, leaving £3,792 to be carried forward to next half-year's account. Alluding to the causes of the decrease in revenue, he said there was no doubt they had suffered from the competition of the Corporation electric tramways, which tapped their traffic at several points. Then they had lost £700 through the closing of Dingle station for repairs after the fire at the beginning of the year. The directors had received many suggestions from shareholders, and they were generally met with the suggestion that they should adopt penny fares, the same as on the tramways. In order to do so, however, they would have to adopt a three-and-a-half minute service instead of the present five-minute service; while, to arrive at their present position as regards income, they would have not only to double their traffic, but to go beyond that point. He would not say that they had altogether dismissed the question of penny fares, but they had decided, in the first place, to try the effect of new up-to-date electrical equipment, so as to afford an accelerated service of 20 instead

of 32 minutes, including stoppages, in performing the journey from end to end. Their new electric motors were to be iron-clad, and the guards' rooms would also be protected, so that it would be impossible for any such disaster as the Dingle fire to occur again. The directors hoped to have trains with the new equipment running by September. They had been in communication with the Lancashire and Yorkshire Railway Company with the view of extending their line to the Seaforth station of the Lancashire and Yorkshire. He was sorry to say nothing had yet come of the negotiations, though he could not say they had ended. The Lancashire and Yorkshire directors felt that they would lose considerable traffic if the physical extension were made at Seaforth. The directors of the Overhead Railway, on the other hand, had some little hesitation in spending £30,000 in making the connection. The matter, though for the moment in abeyance, would have to come sooner or later, for the signs of the times showed that all the great suburban lines, such as the Liverpool and Southport lines and the Garston lines, would have to be worked by electricity. When the Lancashire and Yorkshire Railway felt that the time had come, then he was sure they would require the co-operation of the Overhead Railway Company, with its 17 additional stations. In concluding, he asked the shareholders not to be discouraged, as he believed they had seen the worst of the competition, and would most likely get back some of their traffic through the accelerated service shortly to be introduced.

Mr. Richard Hobson seconded, and the report was adopted.

Newcastle-upon-Tyne Electric Supply Co.—The directors have declared an interim dividend at the rate of 5 per cent. per annum on the preference, and 8 per cent. per annum on the ordinary shares of the company. Warrants for these dividends were posted on 8th inst.

Wigan and District Tramways Co., Limited.—Dividend at the rate of 7 per cent. for the half-year ending on June 30th.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—British Insulated Wire Company, Limited.—Further issue of 30,000 ordinary shares of £5 each, fully paid; and 20,000 6 per cent. cumulative preference shares of £5 each, fully paid. Calcutta Electric Supply Corporation, Limited.—Further issue of 10,000 shares of £5 each, fully paid, Nos. 30,001 to 40,000.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.	Total to date. Am'nt.	Inc. or dec.	Miles open. This year	Last year.
		£	£	£	£		
Blackburn Corp. Trys. ..	Aug. 8	819	+121	16,408	+ 3,120	—	—
Blackpool and Fleetwood	,, 9	1,775	—868	6,517	— 1,167	—	—
Bristol Trys. & Car. Co.	,, 8	6,283	+2,910	—	—	—	—
British Elec. Trac. Co.:—							
Devonport	,, 1	494	+ 41	12,790	+ 444	5	5
Dudley—Stourbridge..	,, 1	793	+ 63	21,294	+ 3,050	18½	18½
Gateshead	,, 1	854	+215	21,643	+ 3,273	10½	9½
Greenock—Pt. Glasgow	,, 1	574	+378	14,641	+ 8,697	7½	7½
Hartlepool	,, 1	389	+ 47	7,410	+ 827	6½	4½
Kidderminster	,, 1	145	+ 6	3,586	+ 34	4½	4½
Merthyr	,, 1	198	— 63	6,137	— 883	3	3
Middleton	,, 1	299	—	5,781	—	8½	—
Oldham—Ashton ..	,, 1	854	+ 41	15,693	+ 599	8	8
Poole	,, 1	310	— 21	7,227	— 121	3½	3½
Potteries	,, 1	1,522	+ 88	44,020	+ 1,632	28½	28½
Southport	,, 1	338	+110	7,167	+ 2,466	5½	5½
South Staffordshire..	,, 1	732	— 71	23,439	+ 573	21½	22½
Swansea	,, 1	467	— 55	13,988	+ 1,343	5½	5½
Taunton	,, 1	69	—	1 664	—	1½	—
Tynemouth	,, 1	448	+ 40	8,129	+ 704	3½	3½
Wolverhampton Dist.	,, 1	305	+296	4,921	+ 3,215	10½	2½
Weston-super-Mare..	July 30	236	—	2,432	—	2½	—
Central London Railway	Aug. 9	6,859	+1,084	39,481	+ 3,529	6	6
City and S. London Ry.	,, 10	2,686	+905	16,274	+ 5,225	6½	4½
Dover Corporation Trys.	,, 9	255	— 19	6,741	+ 135	3	3
Dublin United Trys. ..	,, 8	5,862	—127	29,202	— 705	46	46
East Ham Tramways ..	,, 9	639	+ 29	3,792	+ 469	5½	—
Glasgow Corp. Trys. ..	,, 9	12,826	+784	117,570	— 3,664	55½	44½
Liverpool Overhead Ry.	,, 10	1,797	—120	9,864	— 708	6½	6½
Newcastle Corp. Trys. ..	,, 9	2,911	—	—	—	—	—
Sunderland Corp. Trys.	—	—	—	—	—	—	—

STOCKS AND SHARES.

Wednesday Evening.

The depression which was in full evidence this time last week has happily given way to something a little less cheerless, and markets begin to show a healthier tone, although the full extent of the rise has already been lost in several cases. Under the leadership of Consols, investment groups rallied early this week, and the account which had to be arranged in the Kaffir circus turned out to be much less troublesome than was expected. Moreover, the King is at length joyfully crowned, so that we are less likely to hear repetitions of ill-health rumours than we have been lately from an alarmist section of the Stock Exchange community.

In a quiet way, it is probably within the mark to say that the electric sections are enjoying as much business as any other in the House. Orders are more plentiful than grouse at all events, although the dealers naturally prefer that the fact should not be too widely advertised lest it attract competition on their preserves. Telegraph securities command a fair amount of attention, and rises outweigh the retrograde movements. In the railway list business is quiet, but the electric stocks are not participating in the depression which rules the roost in the steam division. Metropolitan Consolidated has again hardened a fraction. Industrial shares maintain their prices with commendable firmness, and it is more easy to sell than to buy such things as Callender's or Henley's.

The City & Surrey has fallen gracefully into absorption by the National Electric Traction Company, but what particular advantage lies in this the Stock Exchange rather wants to know. Studious inquiries round the markets go to show that the National Electric shares are not dealt in, and most of the people who are asked about them declare that they were not aware of the existence of any such company before the last few days.

Central London issues are unchanged on the week's trading, but City & South London is actually—as apart from quotably—a shade easier. The 4 per cent. Debenture stocks of both companies now stand on a level, and are nominally 115 to 118. It must be noted, however, that the next interest on the Central London stock does not fall due until January 15th 1903, whilst there is a dividend to be paid on the City & South London Debenture at the beginning of November. Metropolitan Consolidated at 83¼ is the fraction better, and Districts are somewhat neglected about 32¾.

Electricity Supply shares display once more a hardening tone, and it is again the Preference issues which are being sought after. London Electric 6 per cent. Preference have advanced to 4½, and there is some little demand for the company's Debentures on the basis of 96—98. Charing Cross "City Undertaking" 4½ per cent. Preferences came into favour, and the price is a shade under par. The reason for the demand appears to be the increasing scarceness of Charing Cross and Strand Preferences, which have improved 5⅜. In this connection it may be mentioned that Westinghouse Preference are exactly 6, and the Ordinary this week have changed hands both at 5⅜ and 5⅞, the transactions embracing a good many shares. The company's Debenture stock is wanted at 103, *i.e.*, at 5 premium.

Traction descriptions of all classes seem to appeal to the average investor with increasing force. London United Tramways Debenture stock will be eagerly taken at 108 in the market, or possibly a little better. British Electric Tractions are good. The Calcutta Electric Tramways Company is issuing new shares at £6, and these are quoted at about 17s. 6d. premium. There has not been much done in them so far, and the old shares are down ½, to 8. The reports of the omnibus companies just out give indications that the Tubes competition is being less keenly felt, or, at any rate, that the 'bus companies are adjusting their routes to better advantage. But the price of fodder eats up a tremendous part of the profits.

In the Telegraph market, a rise of 10s. has taken Globe Ordinary to 9½, but the Preference are unchanged. Eastern Telegraph stock quickly lost the three points which it gained just before the holidays, but the rest of the Oriental group is unaltered. Anglo-American Deferred is slightly better, and there is a little hardening among the Debenture issues of Telegraph group. A rise of £1 has occurred in Telegraph Construction shares.

North Metropolitan Tramways "assenting" shares at 4½, are unaffected by the meeting on Tuesday. What are called the "non-assenting" shares are difficult to negotiate. Nominal quotations of the Electric Company's Preferred and Deferred shares are 22s. 6d. and 5s. respectively, both being of the denomination of £1 each.

The illumination of the Stock Exchange, if plain, was decidedly effective, and the electricians of the House received a good many compliments upon the way in which they carried out the scheme of decoration. White was the prevailing—in fact the only—colour used along the long façade of the Stock Exchange that looks down into Old Broad Street. A much more elaborate design was to have been executed had the Coronation occurred at the time originally planned, but a good many members think that the modified scheme was just as attractive. All interest in the illumination, however, was entirely overshadowed by the exciting finish of the final Test Match.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Aug. 6th.	Closing Quotation Aug. 13th.	Business done during week ended Aug. 13th, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs	100	...	...	...	98 —102	98 —102	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700‖	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ..	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	45 — 48 xd	45 — 48	45	
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	89 — 91 xd	89 — 91	90½	90
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s. %	2s.	6½ — 7	6¾ — 7¼	7⅛	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5 %	3½— 4 xd	3½— 4	...	...
15,333,300§	Commercial Cable	$100	8 %	8 %	8 %	155 —165	155 —165		...
1,741,029‖	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	95	...
16,000	Cuba Telegraph	10	7 %	4½%	4 %	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	...	...	..	12½ — 13½	12½ — 13½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...		7½— 8½	7½— 8½	...	...
60,710‖	Direct United States Cable	20	3½%	3½%	3½%	10 — 11	10 — 11	10 1/16	...
96,300	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	100	99½
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	120 —130	117 —127	120½	118
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	87 — 90	87 — 90	89	87½
1,432,268‖	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	108 —112	108 —112	108	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	11½ — 12½	11½ — 12½	11⅞	11⅝
320,000‖	Do. 4 % Deb. Stock	Stock	...	...	...	107 —112 xd	107 —112	...	...
800,000‖	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	100 —103	98 —101	...	...
200,000‖	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...		98 —101 xd	100 —103 %	...	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	8½ — 9½	9 — 10	9 1/16	9 1/16
160,042	Do. do. 6 % Pref.	10	...	...		12½ — 13½	12½ — 13½	13½	13
150,000	Great Northern Telegraph, of Copenhagen	10	12½ %	15 %	15 %	25 — 27	25 — 27	25⅝	...
70,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	38 — 42	38 — 42	...	...
100,000‖	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	101 —105	102 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ⅜	¼— ½	...	...
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	..	¾— 1	¾— 1	...	
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	97¾	96½
200,000	Do Pref. shares	2	...	3½	3⅜	4⅜— 4⅞	4⅜— 4⅞	...	..
1,966,667	Do Def. Stock	100	...	60	64 xd	56 — 60	56 — 60	58⅜	57⅜
15,000	Do. 5 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	..
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	5 1/16	4 15/16
2,000,000‖	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 98	95 — 98	97½	97
500,000‖	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	102 —106	102 —106	102½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1⅛— 1 1/16	1⅛— 1 1/16	...	...
100,000‖	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	..	99 —102	99 —102	99	...
11,832	Reuter's	8	5 %	5 %	5 %	6½ — 7½	6½ — 7½	...	...
3,303	Submarine Cables Trust	Cert	...			110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	7 %	7 %	4⅜— 5⅛	4⅜— 5⅛	4 13/16	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	..	...	4½— 5	4½— 5	...	...
179,947‖	Do. do. 5 % Debs.	Stock	...	...	...	101 —104	101 —104	...	...
165,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000‖	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	..	...	...	97 —100	97 —100	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	11½ — 12½	11½ — 12½	...	...
75,000‖	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104	101 —104	...	...
848,777‖	Do. do. 4 % Deb. Stock Red.	100	...		...	97 —100	97 —100	...	...
88,321	West India and Panama Telegraph	10	1%	¼ %	...	¼ — ½	¼— ½	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	..	...	4⅜— 5¼	4⅜— 5¼	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 4	3 — 4	...	...
60,000	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	99 —102	99 —102	98¼	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	103 —106	103 —106	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9¼— 9⅝	9¼— 9⅝	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9¼— 9⅝	9¼— 9⅝	..	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 10	9 — 10	9 1/16	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 6	5⅝	5 11/16
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	106½—105½	105 —107	105⅝	..
84,000	*Chelsea Electricity Supply, Ord.	5	5 %	5½%	4 %	5½— 5⅝	5½— 5⅝	...	...
150,000‖	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	..	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	8½— 9½	8½— 9½	9⅜	9¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	11½— 12½	12 — 13	12¼	...
400,000‖	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104	101 —104	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 12⅝	12 — 12⅝	12⅛	..
400,000.	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	109 —112	109 —112	110⅛	..
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	7 %	6½— 6⅝	6½— 6⅝	6⅝	6½
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	...	...
120,000‖	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	..	...	...	106 —109	106 —109	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 4½	4¼ - 4⅝	...	...
250,000‖	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	94 — 99	95 — 100	...	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	15½— 16½	15½— 16½	...	...
220,000	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	108 —112	108 —112	110½	...
250,000‖	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	99 —102	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	13½— 14½	13½ - 14½	14¼	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1½— 2½	1½— 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	80 — 90 xd	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...		2½ - 3	2½ - 3	...	...
109,518	Westminster Electric Supply, Ord.	5	10 %	10½ %	10½ %	10½ 11½xd	10½ 11½	11⅜	11

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years,			Closing Quotation August 6th.	Closing Quotation Aug. 13th.	Business done week ended Aug. 13th, 1902.	
‡			1899.	1900	1901.			Highest.	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	...	5¼%	...	4 — 5	4 — 5	...	...
300,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	83 — 88	83 — 88	...	...
62,074	British Electric Traction	10	8 %	9 %	9 %	12½— 13½	12½— 13½	13⅛	12 13/16
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 13	12½ — 13	12 13/16	12 9/16
600,000‡	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	125⅜	125
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7½— 7⅝	7½— 7⅝	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	5⅝	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ " " " 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Engng., Ord., 1 to 105,731	2	5½%	5 %	Nil	1⅛— 1⅜	1⅛— 1⅜	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1¾— 2	1¾— 2	...	...
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	93 — 98	93 — 98	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	20 %	15½— 16½	15½— 16½	16½	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000‡	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	105 —108	105 —108	107	106
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	106 — 109	106 —109	...	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	103 —106	103 —106	104½	...
855,000	City and South London Railway	Stock	1¾%	1¾%	2 %	71 — 73 xd	71 — 73	72½	71
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	7½%	2⅞— 3¼	2⅞— 3¼	...	...
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and £01 to 11,000 of £50 red	...	...	...	...	101 —106 %	101 —106 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛— ⅜	⅛— ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	1½— 2½	1½— 2½	...	...
344,023‡	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	74 — 78	74 — 78	...	...
100,000‡	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	78 — 83	78 — 83	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 2	1⅝— 2¼	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½— 3	2½— 3	...	...
182,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —100	98 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	5 %	5 %	9⅜— 10½	9⅜—10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	99 —102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16 — 17	16 5/16	...
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½— 5⅝	5½— 5⅝	...	...
50,000‡	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½— 21½	20½— 21½	...	...
300,000‡	Do. do. do. 4 % 1st Mort. Deb ...	100	...	...	...	100 —103	100 —103	100½	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¼%	1½%	4½— 4⅝	4½— 4⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	10 — 10½	10 — 10½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	14½—15½	14½— 15½	...	...
	§Rosling & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	36 — 39	37 — 40	38½	...
150,000‡	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —105	102 —105	...	...
540,000	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 — 95	92 — 95	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅛.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share Lists. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, August 13th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	22/-	22/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£38 10	£38 10	..
a " " ..	per ton	£80	£80	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£18	£18	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a " Caustic (76/80%) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	109/-	106/-	3s. inc.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a " Crystals	per ton	£3	£3	..
a Bichromate, casks ..	per lb	2¼d.	2¼d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b " Wire, in ton lots	per ton	£234	£234	..
b " Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£40 to £140	£40 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	6¾d.	..
c " Tubes (brazed)	per lb.	8¼d.	8¼d.	..
c " " (solid drawn) ..	per lb.	7d.	7d.	..
c " Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8¾d.	8¾d.	..
c " " (solid drawn) ..	per lb.	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. (*continued.*)		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£69	£69	..
g " Rod	per ton	£69	£69	..
c " (Electrolytic) Bars ..	per ton	£63	£63	..
c " " Sheets ..	per ton	£75	£75	..
c " " Rod ..	per ton	£68	£68	..
c " " H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f " Sheet	per lb.	5/-	5/-	..
n German Silver Wire ..	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine ..	per lb.	3/1	2/11½ to 3/-	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants) ..	per ton	51/8	51/-	8d. inc.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i " Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 5 to £11 7 6	£11 5 to £11 7 6	..
g " " Sheet	per ton	£13	£13	..
m Manganin Wire No. 36	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large ..	per lb.	5/8 to 7/8	5/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/3	11½d. to 1/3	..
p " rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p " " strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i " " in bars		£68	£68	..
g Tin, block	per ton	£125 to £126	£127 to £128	£2 dec.
g " foil	per lb.	1/6	1/6	..
n " wire, Nos. 1 to 16	per lb.	1/7	1/7	..
p White Anti-friction Metals —				
" White Ann" brand	per ton	£36 to £60	£36 to £60	..
j Yarns, 2/10s Grey Cotton, cn sp'ls	per lb.	7d.	7d.	..
j " 8 lbs. Flax	per lb.	5¾d.	5¾d.	..
j " 3 ply 18 lbs. Russian ..	per lb.	6½d.	5½d.	..
j " 10 lbs. Russian, single ..	per lb.	4¾d.	4¾d.	..
j " 180 lbs. Jute rove	per ton	£11 10	£11 10	..
k Zinc, Sheet (Vieille Montagne brnd.)	per ton	£28	£28	..

Quotations supplied by { a Messrs. G. Boor & Co. / b The British Aluminium Co., Ltd. / c Messrs. Thos. Bolton & Sons. / d Messrs. F. Wiggins & Sons. / e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works / g Messrs. James & Shakespeare, Co., Ltd. / h Messrs. Edward Till & Co. / i Messrs. Bolling & Lowe. / j Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by { k Messrs. Morris Ashby, Limited. / m Messrs. W. T. Glover & Co., Ltd. / n Messrs. P. Ormiston & Sons. / o Messrs. Johnson, Matthey & Co., Ltd. / p The Phosphor Bronze Company, Ltd.

ELECTRICITY SUPPLY IN SOUTH AFRICA.

We are indebted to the *British and South African Export Gazette* for the following notes showing the position of electric supply in the chief South African towns:—

Commercial development and enterprise in South African towns have proceeded at so remarkable a pace during the last few years that electric lighting schemes were put in hand at an early date by the municipal authorities in all the principal centres with rosy chances of healthy investment, and that anticipations have been more than realised may be gathered from the number and magnitude of contracts for electrical machinery in hand and to come. Appended is a list of some of the towns in South Africa where electricity is supplied either by municipalities or by private companies. It does not profess to be complete:—

Town.	System. (a.c. = alternating; d.c. direct current.)	Consumers' voltage.	Price per unit, Light or Power.	Remarks.
Barberton (Moodie's Gold M. & E. Co., Ltd.)	a.c. 2-phase	—	—	Power and light supplied to mines on the company's estate, generated by water-driven 250-H.P. plant at Queens' River Fall, 6 miles' transmission.
Bloemfontein (Municipal)	a.c. 3-phase	110	1/-	Pop., 10,000. Private and public lighting. Generator capacity, 2,000 volts, high tension. Contemplated expenditure of £25,000 on extensions.
Bulawayo (Bulawayo Waterworks Co., Ltd.)	a.c.	104	2/- & 1/10	Pop., 8,000. Lighting and power. Working voltage, 2,080; periodicity, 125. Steam generation. Price for lighting is, first 100 units, 2s. per unit; power, 1s. 10d.; 300 to 600 units, 1s. 8d.; over 600, 1s. 7d.
Capetown (Municipal)	d.c. 3-wire (formerly 5-wire)	220 & 440	1/2; power, 7d.	Pop., 84,000. Private and public lighting. Monthly rebates, two-rate system for day load. Gas, 10s. per 1,000 ft. Network to be extended and improved at a cost of £100,000.
Cape Peninsula Lighting Co., Ltd., Wynberg	d.c. 3-wire	120 & 240	—	Public and private lighting and tramways. New central station under construction at Claremont to supply the two districts, 5 miles apart, with power at high tension. Plant being entirely renewed.
Rondebosch	a.c. single-phase	110	—	
Camp's Bay Electric Tramways Co., Ltd.	—	—	—	Tramways and lighting. Output of generators, consisting of two direct-coupled 400-KW. sets, is 400 KW. each at 550 volts.
Cape Electric Tramways Co., Ltd.	—	—	—	Tramways.
Dundee	—	—	—	Pop., 2,000. A private installation under negotiation.
Durban (Municipal)	a.c. single-phase	100	8d.	Pop., 57,000. Lighting and traction. Tramways, overhead trolley system. Network 25 miles in extent. Installation only partly completed. Lighting network to be extended at a cost of £30,000, with a combined lighting and power central station at a cost of £45,000.
East London (Municipal)	a. and d.c. single-phase	110	1/-	Pop., 13,000. Lighting and tramways. Alternators and transformers used for lighting, continuous current machines for traction, dynamos and alternators in all cases being direct coupled to engines. Current generated at 2,200 volts. Central station.
Germiston (General Electric Power Co.)	—	—	—	Power and light transmission plant, with 800-H.P. engines. Supplies mines and lights the Germiston and Elandsfontein Railway stations. Steam-generated power.
Johannesburg (Municipal)	a.c. single and 3-phase and series arc	300 & 500	1/- & 10d.	Pop., 80,000. Municipal plant. Overhead wiring for part of town and for the suburbs; cable for small portion of town, including Government buildings. Steam generation.
Johannesburg (Rand Central Electric Works, Ltd.)	a.c. single-phase	120 & 240	—	Power and light transmission plant at Brakpan, 25 miles from Johannesburg. Supplies mines with power, and light to railway stations. 1,000-H.P. engines. Generating power, steam.
Johannesburg (Suburbs)	—	—	—	Several private plants partially supply the suburbs of Johannesburg with electric light. The Braamfontein Estates Co. supply Parktown and the streets in the district; the Standard Theatre supplies some surrounding buildings the Empire Theatre supplies some of the shops in the block; the Rand Club supplies the Permanent Buildings, the *Leader* and the *Star* offices, Exploration Buildings, and Messrs. E. W. Tarry & Co.'s premises.
Kimberley (Municipal)	d.c.	200	1/-	Pop., 50,000. Lighting. Corporation has just obtained power to borrow £10,000 for extensions.
De Beers Co.	a.c. 3-phase	—	power 6d.	New central power station and equipment scheme. Plant, 2,000 KW., equalling 2,665 H.P., increasing to 3,000 H.P. Power generated at 5,000 volts and transmitted at that pressure. For supply of mines, and Kimberley, if desired.
Kingwilliamstown	a. and d.c.	—	—	Pop., 7,193. Private company just formed, but installation not yet completed. Steam-generated power.
Kroonstad (Municipal)	—	—	—	Pop., 2,000. Town authorities purpose installing an electric light service at a cost of £10,000.
Ladysmith (Municipal)	continuous current low pressure	—	—	Pop., 5,000. Municipal lighting installation under construction. Plant, two 440-volt belt-driven dynamos. Steam generation.
Newcastle	—	—	—	Pop., 2,500. Private installation under construction. Service equal to 1,600 16-C.P. glow lamps. Right to supply power. Meter system.
Paarl Electric Power Syndicate	—	—	—	New company just formed to erect a lighting and power installation, generating power from neighbouring stream.
Pietermaritzburg (Municipal)	a.c. single-phase	100	1/-	Pop., 25,000. Lighting and tramways. The latter under construction, and the former system to be extended at a cost of £150,000.
Port Elizabeth (Municipal)	d.c.	—	—	Tramways.
Pretoria (Municipal)	—	—	—	Corporation contemplating erecting its own lighting, power, and traction service.
Pretoria (Pretoria Lighting Co., Ltd.)	—	—	—	Pop., 12,000. Original plant, output equal to 6,000 8-C.P. lamps, with underground and overhead conductors. Plant subsequently increased by addition of 2,000 ampere hours storage battery and three 126-KW. direct-driven dynamos. Highest output in 1899, 477,000 units. Central station. Meter system.
Salisbury (Municipal)	—	—	—	Pop., 1,000. Town Council intend to construct own installation, but a beginning not yet made.
Umtali and Massikessi	—	—	—	Private company just received lighting and power concessions from Mozambique Co., generating power from Massikessi Falls.
Victoria Falls (African Concessions Syndicate, Ltd.)	—	—	—	This company has a concession from the British South Africa Co. to develop energy from Zambesi Falls and River for supplying towns and mines in Rhodesia, &c.

Owing to the disturbance to trade generally during the war, the development of motor driving from the central station supply in the above towns has made but little progress, with the exception of Capetown, and the current rates for these purposes are in most cases under revision, and will be subject to a big reduction from the lighting charges. The following industries in Capetown derive their power for driving motors from the municipal supply mains:—Cold storage: Messrs. Combrinks, 20 approximate H.P.; Bell and Company, 7 approximate H.P.; Mackenzie, 5 approximate H.P. Ventilating fans: Town Council, Parliament Houses, &c. Leather manufacturers: Messrs. Mossop & Garland. Lifts in Government, public and private offices supplied by Otis Elevator Company,

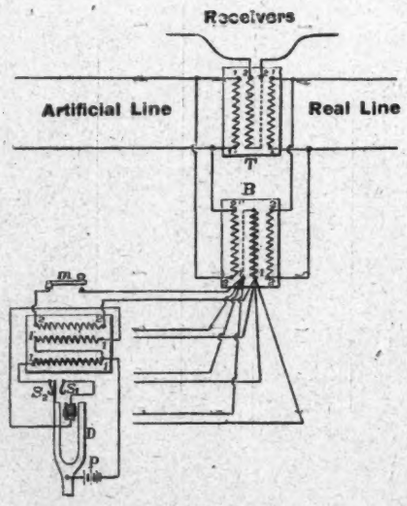
Messrs. Sprague & Co., A. H. Johnson & Co., Waygood & Company, Limited, and G. Findlay & Co. Pumping plants: Corporation stations for sea and fresh water. Printing works: Messrs. Townshend, Taylor, and Snashall. Mineral water manufacturers: T. Mulvihall & Co., and small motors in other premises. Saw mills: Small motors to a few firms. Tent makers and Army contractors: Messrs. Shirley. Waterproof manufacturers: Messrs. Eilenberg & Co., 10 H.P. Wine merchants: Messrs. J. Sedgwick and Co.

THE MERCARDIER MULTIPLEX TELEGRAPH.

The *Journal Telegraphique* of July 25th publishes the last of three articles upon the Mercardier telegraph, by Monsieur J. Anizan. In this concluding article the author treats of certain improvements of which the system appears to be susceptible, founding his conclusions upon experiments recently carried out.

The first and most important is a means of doubling the output of the system without increasing the number of trunk lines in use. In the Electrical Review of July 19th, 1901, and July 26th, 1901 (Nos. 1,234—5, Vol. xlix.), an account of the results obtained by M. Mercardier was given. In this account it was shown how induced undulatory currents were sent by a series of 12 electro-tuning-forks ranging semi-tone by semi-tone from B to A sharp. The receiving apparatus consisted of a syntonised series of mono-telephones responding only to their related tuning-forks. The output, says M. Anizan, could be doubled if it were possible to use plates separated by a musical interval of only a quarter-tone. The practical question needing solution is, Can such a system separated only by quarter-tone intervals be realised? So far as the construction of the plates and tuning-forks is concerned there is no doubt, but the question of maintaining the monophony of the plates under the action of currents necessitates an amelioration in the suspension of the plates above the electro-magnet. The diaphragms, in place of being fixed, must rest on points which enter into conical cavities made in the plate itself. The entire receiver being fixed, this method of support will offer no inconvenience. Having attained the result aimed at, the output is doubled, that is to say, in place of 24 messages being exchanged simultaneously (12 in each direction), it will be possible to exchange 48 (24 in each direction).

By the method in use it is possible to exchange signals on a line 2,000 kilometres in length when only one transmitter and one receiver are used at each extremity. When a complete installation of 12 transmitters and 12 receivers is used, there are numerous causes, among which may be cited the space occupied by the apparatus, which reduce the distance to from 1,200 to 1,400 kilometres. But the main obstacle in the way of lengthy lines is the weakness of the currents. Two means are suggested for augmenting the strength, which can be employed separately or conjointly. The first consists in replacing the transmitter by a Varley transmitter. The second method consists in modifying the connections of the transmitter, as shown in the accompanying figure in which the wires, 2, 2,



of the induction coil, B, and 1, 1, of the transformer, T, are connected in series. It follows, of course, that the wires, 2′ 2′ of B and 1′ 1′ of T in the artificial line are also joined in series. By this means it might also be possible to reduce to a minimum the capacities of the condensers shunting the secondaries of the coil B, or it might even be possible to dispense with them to advantage. An essential would be to suppress the condenser in the real line. The other in the artificial line might be left if its use was indispensable. The suppression of the condenser would result in leaving to the currents sent from the coil B all their strength, as this condenser acts as resistance to the induced currents.

The author also makes suggestions for improving the methods of calling and the inter-connection of stations in *echelon*. But, very properly, he attaches great importance to the augmentation of the intensity of the transmitting currents, because it is by this means that it may be possible to work the multiplex with a single earthed wire in place of the metallic loop now needed. If it were possible, for instance, to triple the intensity of the currents, it would be necessary, in order to obtain the same intensity of sounds on reception, to *de-sensitise* considerably the monophonic receivers. To accomplish this, it is only necessary to increase the distance between the diaphragm and the polarised electro-magnet. Experience has shown that the diaphragms of the system are much more inert than the diaphragms of telephone receivers, and it might be hoped that they would remain insensible to the induction of neighbouring wires. This result could be obtained by removing them a sufficient distance from the electro-magnet. If the currents from the sending station were of sufficient intensity to operate diaphragms so removed, we should have obtained a practical realisation of the interchange of harmonic signals by a single wire. If this were accomplished, in addition to solving the problem of separating the transmitting forks by only a quarter-tone, the output of the system would be enormously increased, for we should get 48 simultaneous transmissions with a single wire.

These speculations are of considerable interest, the more especially as they are stated to be founded on experiment, but we think that only a lack of practical experience could lead M. Anizan to say "The work of an employé with the multiplex can be valued as of the same order as that of the same employé with a sounder." Our own experience of all forms of multiplex working is that the individual output is considerably lessened. Roughly, it might be said that the output of each operator employed on a multiplex is decreased by at least one-sixth, as compared with his work on a single or duplexed sounder.

TEST OF SOUTH AFRICAN PLANT.

A quantity of plant for South Africa was recently tested at the works of Messrs. Rosling & Fynn, Limited, particulars of which may be of interest to our readers

The complete plant consists of:—

1. A motor generator, with an output of 130 kw. at 500 volts on the direct current side, the motor being a synchronous three-phase machine taking current at 3,000—3,300 volts. This set is so designed that the direct current machine can be used as a motor, if required, to drive the alternator.

2. A motor-driven balancer and booster set, consisting of a three-phase synchronous motor, taking current at from 3,000 to 3,300 volts, and driving two balancers, having each an output of 250 volts and 100 amperes, and two boosters with an output of 100 amperes at 10 to 70 volts.

3. A balancer and booster set of the same respective outputs as above, but not motor-driven.

The motor-generator runs at 600 revolutions on a 60-cycle circuit, the balancer and booster sets at 900 revolutions. The motor-driven balancer and booster set is to be used for light loads, and also to enable the main generator to work on a three-wire system in conjunction with a storage battery. The current is to be used for traction and lighting.

The A.C. motor, of which we give an illustration (fig. 4), is of the revolving field type, the induction being homopolar through the laminations and heteropolar through the armature coils. The field

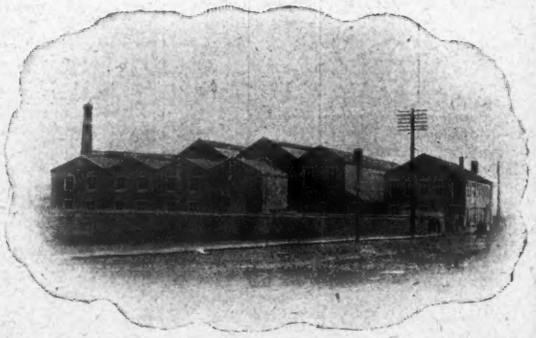


Fig. 1.—Messrs. Rosling & Fynn's New Works, Thornbury.

coil is stationary, and is supported on the armature; the revolving field is a steel casting with laminated pole-tips, held in place by rivets (fig. 3). The armature coils are former-wound and mechanically held in place, the usual wood wedges and similar devices being entirely avoided. The terminals are totally enclosed in cast-iron boxes, and may be termed "fool proof."

The machine will give 150 kw. as a generator at 600 revolutions, and was only selected as being the nearest standard size corresponding to the specification.

The direct-current generator coupled to it is a six-pole slot-wound machine, with laminated pole and cast-iron yoke. A heavy brush-rocker carries six sets of carbon brushes, which can all be separately adjusted and also simultaneously shifted by means of a worm. Fig. 2 shows a general view of the machine.

The power available was not sufficient to test the motor-generator set to full load, and a pressure of only about 430 volts could be obtained on the D.C. side. The field of the D.C. generator, used in the test as the motor, was accordingly very materially weakened in order to obtain the full speed. The shunt current was actually reduced from 3·2 to 1·45 amperes when the machine was carrying 216 amperes with 430 volts at terminals at 600 revolutions. Under these trying conditions there was absolutely no sparking to be observed under the brushes when these were anywhere within the no-load zone, and the commutator showed a perfect polished surface after a six-hours' run. The coils were dead cold, the commutator just warm, and the armature had risen 44° F. The no-load zone extended over seven commutator sections.

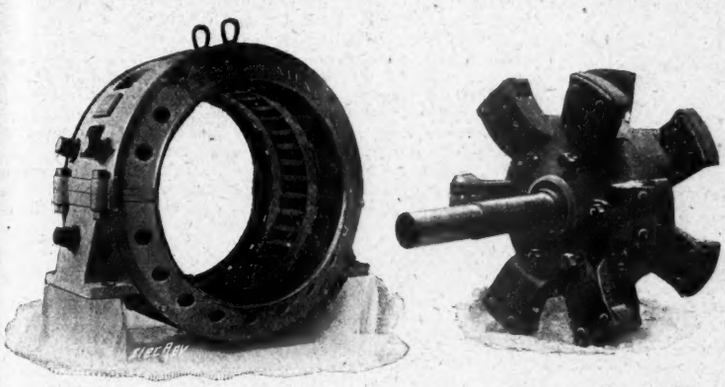


Fig. 3.—Stator and Rotor of Three-Phase Synchronous Motor.

The three-phase motor was first of all tested as a generator at a reduced speed and proportionately lower voltage, so as to be able to reach full-load current under normal field conditions, and it was found that the voltage rose slightly over 4 per cent. when the full load was thrown off and the excitation and speed were kept constant. The load was non-inductive.

The saturation and short-circuit curve of this machine were taken under normal conditions, and these, of course, furnish all the required data for judging the probable behaviour of the machine under various conditions of load.

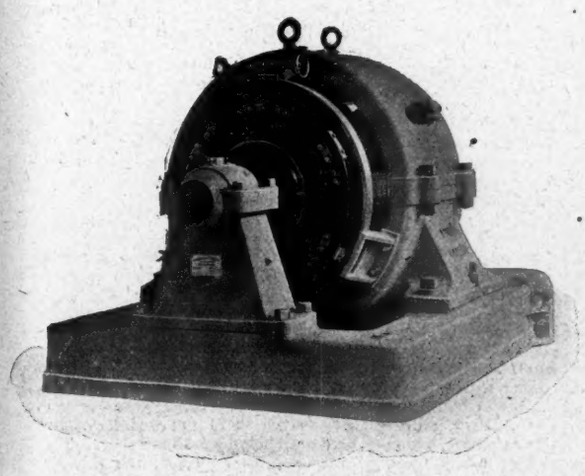


Fig. 2.—130 kw. Dynamo.

It is well known that motors and generators with only one slot per pole per phase have very often been found to work unsatisfactorily in conjunction with other machines, owing to their peculiarly shaped E.M.F. curve, and such a construction is now being avoided when possible, notwithstanding its cheapness.

The curves thus obtained often show very marked odd harmonics, which give rise to more or less heavy equalising currents; and machines of the homopolar induction type often give an E.M.F. curve with unsymmetrical quarter periods. The machine under consideration, however, showed none of these drawbacks, owing to the special shape of pole, which had been predetermined with the object of eliminating these defects, and which was found to answer the purpose perfectly.

In running, the only sound emitted was due to air churning, it being quite impossible to detect any difference when the exciting current was switched on or off.

The six hours' test which was carried out was, as already stated, limited by the available power. The motor-driven balancer and booster set was driven from the three-phase side of the motor generator, the direct current generator running as a motor; but it was only possible to get 80 per cent. of the full load on the small set. To reduce the number of readings, the two balancers were put in series and the two boosters as well.

In judging the overall efficiencies given, it must be remembered that we are dealing with four conversions, and that the machine driving the whole was working far under its load, and under abnormal conditions. The three-phase generator was only giving out 47 per cent. of its full load and the balancer set only 80 per cent.

The highest temperature rise was found to be 58° F. in the laminations and field coil of the small alternator. The readings were all taken simultaneously on instruments calibrated for the occasion.

The three-phase voltage given was measured from the neutral point to one of the terminals, and the line voltage is therefore obtained by multiplying the observed value by $\sqrt{3}$. The volts and amperes for both the alternators are the same, as there was no line loss.

All the machines, with the exception of the direct current motor, were separately excited off 230 volts, and the power absorbed for this purpose was taken into account in calculating the overall efficiencies.

The direct-current machines in the smaller set were provided with carbon brushes, and carried their full load sparklessly either as motors or as generators with the brushes always in the same position, namely, in the centre of the neutral zone.

A special test was made to see whether the boosters complied with the specification, and it was found that it was possible, without ever moving the brushes, to reduce the pressure from the maximum value of 70 volts, not only to 10 volts as specified, but to 0 with full load current, and the current could even be increased to 135 amperes before any sparks at all were observed.

Seven sets of readings were taken, which agreed between themselves to a remarkable degree, the overall efficiences varying between 59·7 and 61 per cent. We give below the results of one of these tests nearest the average.

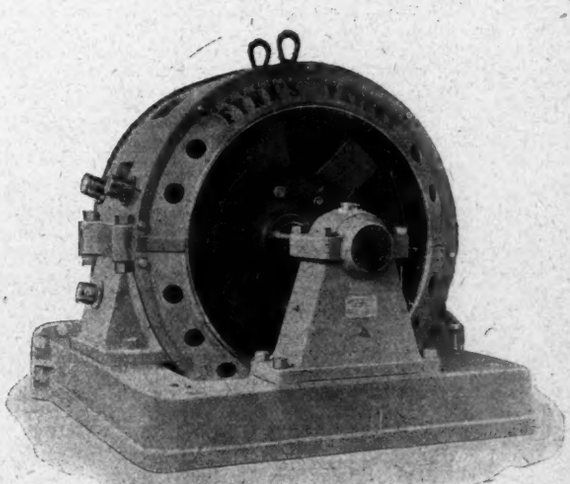


Fig. 4.—Three Phase Synchronous Motor.

We give on p. 282, a view of the new works which have recently been built by Messrs. Rosling & Fynn, Limited, at Thornbury; the removal has begun, and it is hoped that work will be in full swing on the new premises by the end of this month.

Direct-current motor.			Three-phase generator.				Three-phase motor.			Balancers.			Boosters.				*Efficiency.
Volts.	Amps.	Ex. amps.	Volts.	Amps.	Ex. amps.	Speed.	Volts.	Amps.	Ex. amps.	Volts.	Amps.	Ex. amps.	Volts.	Amps.	Ex. amps.	Speed.	
422·9	214·8	1·425	1,815	13·2	4·03	569	1,815	13·2	2·467	526	84·5	2 21 2·19	133·6	76	1·45 1·5	851	60·3 %

* Overall efficiency of the four conversions.

ESTIMATING THE POWER OF MOTORS.

The report of Dr. Rasch to the Tramways Congress of 1902 points out that the German regulations regarding motors classify three kinds of service, viz., intermittent, momentary and continuous, and a motor should be rated for power according to the variety of service for which it is intended.

If this is so, ought not every motor to be stamped with the output of which it is capable on each class of duty?

Traction motors, of course, come under the first category, and when tested must be closed up exactly as when in service. The same regulations hold that on a trial of one hour a traction motor should not at normal rating rise in temperature beyond permissible limits. The reporter thinks a one-hour test is not sufficient, because though normally loaded below its average, it has to work through a period of 14 to 16 hours daily. He endeavours to formulate the results of a study of the question by M. Max Müller. The formula is

$$x = \frac{t\,T_1}{t + 28\,(T - T_1)};$$

where x is the required duration of trial to be made;

T = time the car is out of the depôt;

T_1 = " " working; and, therefore,

$T - T_1$ is the cooling period.

t is the permissible excess of temperature centigrade above atmosphere, and the assumption is that 28° C. per hour will be lost by radiation and convection.

Thus, if a motor works 7·3 hours out of a day of 14 hours, the value x will work out as two hours as a suitable test at full load.

As regards overloads, the same regulations do not allow that an overload of 25 per cent. should continue more than half an hour for generators, motors, rotary converters and transformers, and they allow an overload of 40 per cent. for three minutes, which usually will be thought insufficient, but is sufficient if the motor is rated high enough. An hour's trial load is really greater than the working load.

In reply to questions, one company asks for an overload of 100 per cent. during several seconds. Another asks the same for five minutes with a temperature rise 20° C. less than usually required. The German regulations as to temperature rise allow, when the atmosphere does not exceed 35°, or, say, 95° F.:—

For cotton insulation 50° C. = 90° F.
" paper " 60° C. = 108° F.
" mica, asbestos, &c., 80° C. = 144° F.

For stationary coils an additional 10° C. = 18° F. all round is allowed.

For traction motors the limits may be increased even 20° C. = 36° F. if the trial is made in a test room, presumably to allow for movement of the car promoting cooling.

M. Dettmar considers that for cotton insulation a stationary winding may be allowed a temperature of 95° C. = 203° F., but this should not be permitted on rotating coils.

It is considered by many, and agreed to by the reporter, that the first quality of a motor is not high efficiency, which may be secondary to other considerations. The tractive power of a motor evidently depends on four factors—torque, gearing efficiency, gearing ratio and wheel diameter. Only the first properly belongs to the motor, and it is advised to characterise motors by two factors, M and N—M being torque in kilogram-metres and N the revolutions per minute.

These two factors are related to the power, W, in watts, as follows:—

$$W = \frac{2\pi 9{\cdot}81}{60} M N = 1{\cdot}028\ M N.$$

The factor 9·81 is, of course, the metrical coefficient of gravity. This does not represent the input of the motor, but the output, or 92 per cent. to 97 per cent. of the input. Admitting an efficiency of 95 per cent.—this seems high—we have

$$w = \frac{W}{0{\cdot}95} = 1{\cdot}08\ M N.$$

A motor designated 20/550 would then be one that at normal load gave a torque of 20 kilogram-metres at 550 revolutions per minute.

Its input would be 1·08 × 20 × 550 = 11·9 kilowatts, or 20 amperes at 600 volts.

W. H. B.

THE GERMAN ELECTRICAL INDUSTRY.

More unsatisfactory Results.—The Optimism of English Scientists viewed from the Labour Standpoint.

The crisis in the German electrical engineering industry has by no means passed away, as is shown by the reports of the various companies, and more attention is now being paid to the question of the new tariff, in view of the fact that the Commission engaged on the consideration of the scheme has completed the sections which relate to mechanical and electrical machinery and plant. If these sections of the bill are finally adopted, and the highly protective tariff prevents the conclusion of new commercial treaties—the existing agreements expire at the end of 1903—it is considered that the Teutonic electrical trade will be restricted to Germany in the future. In this contingency, the requirements of the country would be met by a comparatively small portion of the existing works. Meanwhile, as the Association of German Electrical Engineers does not deal with commercial questions, an organisation has been formed under the title of the Association for the Protection of the Common Economic Interests of the German Electrical Industry. The council of the Association comprises Herr E. Adt, of Ensheim, Herr A. Haeffner, of Frankfort-on-Main, and Herr G. V. Lynen, of Stolberg, whilst the secretary is Dr. R. Burner, of Berlin.

Some important electric railway schemes are at present under consideration. One relates to Hamburg, where the municipal authorities, after an inspection of the elevated and underground railway in Berlin, and the suspended railway at Elberfeld-Barmen, have instructed the Continental Company for Electrical Enterprises, of Nuremberg, to submit a scheme for an urban and suburban line on the suspended system; whilst a similar railway is projected between Berlin and Rixdorf. The Continental Company may be remembered as the trust for the Schuckert Company. In mentioning the latter it should be stated that the company, as was the case a year ago, does not prospose to pay any dividend for the financial year which recently terminated, owing to the enormous loss of £770,000 having been incurred during the year. The Lahmeyer Company, too, has been exceedingly unfortunate, and is actually coming forward with a proposal to issue fresh bonds to the extent of £300,000. If the emission is proceeded with and is successful, it will be as great a surprise as the heavy loss incurred by the company during the past year.

It is never a prudent policy to underrate the competitive capabilities of trade rivals, but on the other hand it is possible to portray them in too brilliant colours. In the course of his evidence placed before the Technical Education Board of the London County Council, Mr. J. W. Swan states that "in electrical industries the business is carried out on an enormously larger scale in Germany than in England; as an instance, one of the largest German electrical engineering firms had recently on their books orders amounting to £10,000,000." It would be interesting to know the name of the firm. Was it the Siemens & Halske Company, the Allgemeine Company, the Schuckert Company, the Union Company, the Lahmeyer Company, or the Helios Company? Ten millions sterling yielding 10 per cent. means a profit of £1,000,000; producing 5 per cent. it implies a profit of £500,000. Where is the company which has earned the latter profit during the past two years, let alone the possession of orders on the books on any one day, week or month of the value of £10,000,000? Or is the alleged possession of orders to this extent synonymous with heavy monetary losses? Then, again, Prof. Fleming, also in his communication to the Technical Education Board, thinks "it is certain that the prosperity of many great businesses in Germany, such as that of Schuckert, the great electrical engineering firm . . . , the Allgemeine Elektricitäts Gesellschaft, of Berlin, and others, is due to the great intelligence of their directors and managers in expending such large sums on scientific research in connection with their businesses." Admitting the position of the Allgemeine Company—although the last dividend which was paid nearly a year ago amounted to 12 per cent. as against 15 per cent. in each of the four preceding years—Prof. Fleming could not have been more unfortunate in his selection of the Schuckert Company, with its absence of dividends for the past two years, as the first example of the prosperity of many great businesses in Germany. Let it be said to the credit of Mr. John Burns that exaggerations respecting the progress in the Fatherland do not lead him to the belief that the English engineering trade is going to the dogs for the alleged lack of technical education. When the Battersea Knight of Labour addressed the County Council on the subject the other week, he declared that on the occasion of a recent visit to Berlin he found that out of 117,000 men associated with the engineering and electrical industries in that city no less than 27,000, or 26 per cent., were out of work. On the other hand, taking the same number in the same trades in England the men out of employment only amounted to 3 per cent. The figures in regard to Berlin appear to be correct, judging from the statistics published by the labour organs issued in that city, and if this be the case, the worst has not yet been reached respecting the works in the German capital.

The position of the Lahmeyer Company, of Frankfort-on-Maine, as indicated by the preliminary statement which has been issued by the directors prior to the publication of the annual report for 1901-1902, is more astounding than one had been led to expect, whether rightly or wrongly, from the pessimistic rumours which have been circulated on the Stock Exchanges during the past month or two. Having distributed as much as 11 per cent. for one year of its existence, and even paid a dividend of 10 per cent. for 1900-1901 on a share capital increased to £500,000, the heavy loss incurred during the past financial year has come as a complete surprise to the shareholders, if not in certain other quarters. Including the balance brought forward from the previous year, the gross profits amount to £113,512 as compared with £215,805 in the preceding 12 months. After meeting interest payments on the bonds, providing for ordinary depreciation and covering the working expenses of £116,586, the statement shows a loss of £124,693 owing to the necessity which has arisen for writing off or making provision for depreciation of investments, doubtful business, advances to electricity works, &c., to the extent of £97,479. The total deficit is covered by drawing upon the reserve fund, which thereby becomes reduced to £4,000, but it will be seen that even if the obligation to provide for extraordinary depreciation did not exist, the working results for the year alone would show a loss of over £27,200. The directors attribute the unfavourable position, firstly, to the extra provision for depreciation; secondly, to the great depression in the prices of manufactures combined with the possession of large stocks of raw materials which were bought at high prices; and thirdly, to the losses incurred in connection with the

Russian branch, the operations of which are now being curtailed. In commenting upon the unfortunate position of the company, a communication, apparently emanating from a competitive company, states that the Lahmeyer Company has concluded contracts and incurred risks which bear no relation to the finances of the undertaking, and that, although most of its rivals are better equipped for manufacturing purposes, they could not compete with the Frankfort concern in the matter of prices, because the latter desired business at any price whatever; and further, that the expenditure on the Paris and Dusseldorf Exhibitions has been excessive, amounting to £75,000, and that even if the exhibits are sold, the transactions will only be effected at a sacrifice which is out of all proportion to the success obtained, and which will lead to a further reduction in prices in the whole trade. It appears, however, that apart from the alleged cutting of prices, three-fourths of the exhibits at Dusseldorf have been disposed of, and that the outlay on the two exhibitions has only amounted to one-sixth of the sum in question. But, after all, the outlook is far from being of an encouraging character. The capital of the company now stands at £1,000,000, the increase from £500,000 having been effected for the purpose of acquiring the shares of its trust (the German Company for Electrical Enterprises), and the bond issue, which amounted to £300,000, has been advanced to £700,000 in order to absorb the bonds of the same trust. It is now proposed to make a fresh issue of bonds to the extent of £300,000, which will bring the loan debt on an equal basis with the share capital of £1,000,000. The fact of a further charge being sought to be imposed upon the undertaking has not been received with pleasure in view of the past year's working results.

The Watt Accumulator Works Company, of Berlin, which had a share capital of £75,000, has been so unsuccessful since its formation that the shareholders have decided to wind-up the concern by voluntary liquidation. At the general meeting held a year ago, a scheme of reorganisation was approved which provided for the payment of additional capital on the shares, but as the minimum amount which was fixed has not been received, the only course open is to terminate the operations of the company. It is considered that the Watt accumulator patents are of value, and the battery capable of development, but the company lacks the means for becoming prosperous. The German Genossenschafts Bank, and the banking firm of Koenen & Co., have already made such large advances that it is impossible for them to grant further loans to a company which only possesses a single utilisable article. The battery, which was originally intended for use in connection with the operation of electric tramcars, has proved to be inapplicable, whilst years of experiments would be required to render it remunerative as applied to the propulsion of boats. It is considered that the accumulator could only be converted into a prosperous business by having large financial means at the company's disposal or the support of a banking institute or electricity company, but the bank connections have acted in the most liberal manner in the past, and are unable to do any more. In addition, the working expenses have been so high that very considerable orders would be necessary to meet them, and taking all things into consideration, the liquidation of the company seems to be the best termination to an undertaking which has only resulted in loss from the time of its inception.

The Helios Company, of Cologne, which after absorbing the reserve fund closed its financial year for 1900-1901 with a deficit of £245,000, has not yet issued its report for the past year. At that time the directors expressed the hope that by means of a reconstitution of the board, by refraining from embarking on promotion business, and by restricting the activity of the company to the development of its own manufactures, it would be possible to restore the undertaking to its former position of prosperity; and no doubt was entertained that satisfactory results would in time be obtained on this basis. It was then thought that a reorganisation of the company would be unnecessary, but the healing power of time has proved deceptive, as the directors now propose a decisive reduction of the shares and the provision of fresh capital. The details of the scheme have not yet been published, but the proposal for raising money is understood to take the form of an issue of 6 per cent. preference shares, a portion of which is to be exchanged for existing bonds. The company would then still have a loan debt of £700,000 and a bank debt of £300,000. The banks associated with the company have arranged to allow credit for a period of five years at a fixed rate of interest of 4 per cent. The financial scheme of reorganisation, the details of which will shortly be made known, will be submitted for the consideration of the shareholders at the general meeting to be held in September.

The North German Cable Works Company, of Nordenham, which has a share capital of £200,000, has decided to increase this to £300,000 by the issue of new shares at a premium of 2½ per cent., the money being required for the purpose of enabling the company to complete the construction of the second German-Atlantic cable. According to the directors' report, the sale of manufactures during the past year yielded £23,686, as compared with £3,836 in the previous year, and the laying and improvement of cables produced £13,836, as against £1,843, whilst £1,071 was derived from rents and bank interest. On the other hand, the expenditure amounted to £27,839, as compared with £2,420, thus leaving a net profit of £10,754, which has been entirely written off for depreciation of works and the cable steamer. The report states that various extensions were carried out at the works during the year, and a further enlargement will be made this year in connection with the manufacture and laying of the new cable to the United States. The order given by the Imperial Post Office for a fifth German-English cable from London *vid* Borkum was completed, and the cable laid in May, 1901, whilst various small contracts were received in the summer from the Government and the German telegraph companies. At present a three-core cable is being laid from Wangeroog to the Rothesand Lighthouse. The company has placed an order with the Vulcan Shipbuilding Company, of Stettin, for the construction of a second cable steamer capable of carrying 5,000 tons, and required for the laying of the second Atlantic cable and other proposed extensive cable lines; and full employment of the works appears to be assured for the current year.

The Electrical Investment Company, of Cologne—the trust of the Helios Company—has been successful in carrying through the scheme of reconstruction which was approved at the last general meeting, and which provided for a reduction of the original capital to £375,000 and the increase of the capital to £500,000 by the issue of preference shares. At present the capital is divided into equal amounts of ordinary and preference shares, and agreements have been entered into with the Helios Company which alter the financial arrangements of the two concerns in regard to shares held in various companies. Without entering into any details respecting these agreements or the different investments of the company, it may be mentioned that the directors' report for the year ended June 30th shows a surplus of £12,920, which is proposed to be carried forward to the next account. There is, therefore, not to be any distribution for the past year on either the preference or the ordinary capital, but in view of the carry forward and the expected development of the various undertakings in which the company is interested, the directors hope for the current year to be able to effect the full service of the preference dividend in addition to a small interest payment on the original shares. The ordinary shareholders, who have incurred such heavy losses in the past, reciprocate the hope expressed in the present report.

The share and bondholders of the Kummer Electrical Company, of Dresden, which went into liquidation in connection with a serious bank failure which took place a year or two ago, have now appointed a committee to investigate a scheme for the reorganisation of the undertaking. Over 200 persons attended a recent meeting at Dresden, when a report was presented by Herr Horn indicating that the Kummer works must be purchased and continued if it is desired to prevent further considerable losses from being incurred, although the present position of the electrical industry does not justify the formation of an optimistic judgment on the subject. The report submitted that if the Niedersedlitz works could be purchased for £75,000, it would gradually be possible, with technical management, for the buyers to recover the amount of their losses. The equipment and machinery are said to be capable of being productive, although consisting partly of old types which would have to be replaced. Whether the scheme will eventually be carried through remains to be seen, but it is now reported that in the event of the Niedersedlitz works being put up to auction, an important Saxon financial institute proposes to become the purchaser for the purpose of establishing the motor car industry on a large scale.

The directors of the United Electricity Works Company, of Dresden, which was formed in 1897 with a capital of £30,000, for the purpose of acquiring the installation business of Oscar Beyer, and whose capital has since been increased to £95,400 by the purchase of various works, have resolved to recommend the voluntary liquidation of the concern, owing to its unfortunate financial position. Severely hit by the collapse of the Kummer Company and the general depression in the electrical industry, the company has endeavoured to carry through a scheme of reorganisation, and by this means and the closing of the branches in Hamburg, Breslau, Gera, Konigsberg, and Vienna, it was hoped to place the undertaking on a satisfactory basis. As this expectation has not been fulfilled, the directors have considered it advisable to adopt the course already indicated.

Among other companies which may be briefly referred to, may be mentioned the Korting's Electricity Company, of Hanover, which proposes a dividend of 6 per cent. on a capital of £150,000; the Westinghouse Electricity Company, of Berlin, has incurred a loss of £9,396 on a capital of £50,000, of which £12,500 is paid up; the Rhenish Schuckert Company, of Mannheim, pays 4 per cent. on £112,500, as against 7 per cent. on £75,000; the Lippe Company, of Detmold, shows a profit of £1,812; and the Esslingen Engineering Works distributes 5 per cent., as against 6¾ per cent. a year ago.

THE ARBITRATION BETWEEN THE METROPOLITAN ELECTRIC SUPPLY CO. AND THE MARYLEBONE BOROUGH COUNCIL.

The proceedings of this arbitration between the Metropolitan Electric Supply Company, Limited, and the St. Marylebone Borough Council to decide what price shall be paid for the Marylebone portion of the company's undertaking, were resumed on Monday, August 4th, at the Surveyors' Institute, Westminster. The tribunal consists of Mr. G. A. Russell, K.C., umpire, assisted by Mr. Richard Vigers and Mr. W. C. Ryde sitting as arbitrators. The case for the company having closed at the last sitting, Mr. Fletcher Moulton, K.C., proceeded to open the case for the Marylebone Borough Council. He said that the task before the tribunal was not an easy one, because it was a very novel one. They had to value an undertaking of a kind which, though common now, had only existed during the last few years, and in which there had been

little experience of the ultimate fate of such undertakings, and still less experience in the mode of valuing them. The company had put in a claim based not on the particular circumstances of their undertaking—they had put forward an estimate resting almost entirely on hypotheses which he thought were not supported by the circumstances of the case, and the sole warrant for which was the effect of imagination, no doubt honestly exercised by the witnesses. He agreed that when they were valuing something which was substantially in the future they must to some extent make hypotheses—they had not got any certainty as to what would happen in a few years. It would be his desire to the best of his ability to show the tribunal what was a fair value for the undertaking, and to do so they had to face to a certain extent the difficulties of the future. He thought he would be able to show that they could foresee that future with much greater accuracy than the loose suggestions which had as yet been put before the tribunal. In using the words "loose suggestions," he did not mean that there had not been a vast amount of industry and great ability shown in the composition of the various tables which had been put in. So far as accountants' work was concerned, these tables were, no doubt, accurate and careful, but the value of the inferences which were sought to be drawn from them was destroyed by the actual results. The undertaking to be valued was not one whose circumstances were ordinary, because when the company applied for its powers it was obliged to come to terms with the local authorities, and it only obtained the consent of the local authority by entering into a contract, the terms of which seriously modified its position. But in valuing the undertaking, the company had done so upon the hypothesis that those obligations did not exist. Having explained at length the agreement entered into by the company with the Marylebone Vestry in 1889, which, he contended, provided for a self-contained supply to Marylebone, counsel dealt with the existence of the Willesden station, which, he submitted, was not to be allowed to interfere with the agreement of 1889. The company, he said, got Willesden on the terms that their undertaking was not to be affected at all by the powers which Parliament gave them to supply from that place. The company arranged that Willesden should be the source of supply, and by so doing were leaving the Marylebone stations absolutely at variance with Clause 1 in the agreement. The consequence was that they thought that sale was better than having to practically re-instal the company in Marylebone with an adequate installation which they could appropriate to the supply of Marylebone. The undertaking the tribunal had got to value in Marylebone was so unequal to the task that he thought he would be able to show by witnesses that practically what there was in Marylebone was worthless except the mains—that in order to perform its obligations under Clause 1 of the Agreement everything would have to be made new; the whole of the plant would practically have to be got rid of, and the whole of the buildings would practically have to be reformed. They would find that what there was in Marylebone was practically a plant which the company had not used to anything like its full extent because it was antiquated; it was impracticable; it was uncommercial; it was quite unequal to supply the demand, and if the company began to set itself in order and to keep the obligations of Clause 1 of the contract, the first thing it would have to do was to make a clean sweep of everything except the mains in Marylebone. That was a point of very great importance to the Borough Council, because, supposing this was the end of the concession, what would they have which would enable them to continue the supply? They would be quite unable to do it, and the very condition that they put in for their protection would, by reason of the management of the company, leave them entirely at their mercy. Whether they bought now or at the end of the concession the meaning of Clause 1 was the same, and they ought to be able to step in to a complete self-contained system now, just as it was contemplated that they would be able to step in to a complete self-contained system at the end of the concession.

The Umpire said the tribunal was conscious of the grave importance of the point Mr. Fletcher Moulton had been urging, but there was another question which arose in connection with it to his mind, viz., that they were sitting there under the Lands Clauses Act.

Mr. Fletcher Moulton remarked that that point had been before the Borough Council. They were not making any claim for breach of contract.

The Umpire said that the whole point was whether Mr. Fletcher Moulton was right in saying that if some third party had bought instead of the Vestry, the third party would have bought subject to those obligations. The question was whether the third party would not have bought free from the obligations, leaving the Vestry to have its remedy against the company for their breach.

Mr. Moulton said there might be a case where a third party would get a worse bargain, because it was not a question of what it was worth to him, but what it was worth to the people from whom they were taking it—the vendors. It was no question of its running with the undertaking; the question of running with the undertaking might affect the value in the hands of the third party, but the question here was what was it he took from them? It must be valued at what it was worth to them. The question of what it was worth to the third party had nothing to do with it. There was no idea of transfer in the valuing under the Lands Clauses Act. There was an idea of holding, and, therefore, the point that the Umpire had raised never could come in under the Lands Clauses Act, because that Act was taken from the point of view of the man holding it—what it was worth to him, not selling.

The Umpire said there was all the difference in the world between that which was a restriction upon the property, and affected the value of the property, and that which was a mere breach of contract.

Mr. Fletcher Moulton: Oh, yes.

The Umpire: And my property is not worth the less to me, because I may have done something to it which has rendered me liable to pay £10,000 to another person. This company may have rendered itself liable to pay a large sum by way of damages to Marylebone, but that does not affect the value of this property to a purchaser—the value of the property taken by itself; I mean for the purpose of selling.

Mr. Fletcher Moulton said that was what he wanted to deal with, but he must do so by stages. The first thing he wanted to make clear was that the valuation in the Lands Clauses Act did not imply transfer. Anything which lessened the profits of the undertaking, whether it was by actual expenditure, or whether it was by limitation of income, if it affected the value to the person who was possessed of it, that had to come into consideration in the compensation that was to be given to him. What passed from the company to the Vestry was their installation in Marylebone, coupled with this—that it had got to be changed into something which would do the Marylebone work. Continuing, Mr. Moulton maintained that the moment they had a property which they could not sell without consent, they could no longer talk about its value in the market, especially as in the present case the person who had got the restrictive covenant, or who owned the burthen, was the person whose consent they would have to get.

The Umpire said that of course if a man could not sell something free from a certain obligation, everybody understood that that affected the valuation to him, but the point was, that if he could sell it free from the obligation, could the existence of the obligation be said to affect the value?

Mr. Fletcher Moulton replied that in the present case there was no power of selling, and therefore the question as to whether a person could take it into the market and sell did not arise. On the question as to what anybody else would give for the undertaking, he said he would be delighted to put it on that basis. He would be able to show exactly what the feeling in the market was as to what was worth giving. The claim was about five and a half times the capital invested in the work, and most of it was lost, and if they looked at the prices of the shares, they would see that the most people were prepared to give was by no means anything of that kind. The company were calculating on holding it in their hands, and defying the obligation which they had undertaken to keep, even to the last stage, when they got Willesden, so that if they were going to value it by any appeal to future profits, they must assume that as a burthen on the undertaking.

The Umpire: Your point is, that they can only claim for such profits as they could have earned consistently after observing the agreement?

Mr. Fletcher Moulton: Yes.

Continuing his address on Tuesday, August 5th, Mr. Fletcher Moulton said he was not going to suggest that there had not been attempts to introduce competition into Marylebone, which had failed, but he was going to point out that they should trace the cause of the failure, and that the cause of the failure was in nothing which they could assume would continue and would be continued in the future; but the reason why competition was not active in the district was simply because the local authority itself asked that the company should keep competition out.

The Umpire: They were doing that for their own purpose, and not for the benefit of the company.

Mr. Fletcher Moulton: Yes.

Mr. Balfour Browne, K.C.: And once they promoted a Bill themselves to compete.

Mr. Fletcher Moulton: Precisely. They were, he continued, perfectly willing to compete, but they wanted to compete themselves and keep other people out. They did not disapprove of competition. Their attitude, on the contrary, was in favour of it, but they wanted the competition themselves. Mr. Moulton then gave the history of the company since its inception, and said that so far from what they were buying being an unchallengable monopoly it was so far from a monopoly that, in the ordinary practice, Parliament would, in a very short time, have given competitive powers to some other company if it had not been that the Vestry came in and purchased the undertaking. What they were buying was the undertaking in Marylebone, and what they were to give for it was its value in the hands of its owners. It was an extravagant value to put upon it to estimate it as though it was an unchallengable monopoly. In law it was no monopoly at all, and when they came to look at the facts there was every probability that in future competition would be admitted. The company saved themselves from realising that defect in their undertaking in the form of active competition being let in, by agreeing to sell. But the Vestry were entitled to have the undertaking as one liable to have and likely to have a competitor, and it was needless to say that that entirely altered the scale on which the valuation must be made. Coming to the question as to how the valuation ought to be made, he said there was no doubt that a question like that in the case of a new type of undertaking was one of considerable difficulty. If those were things that were sold every day—if they were like leases or businesses, or like collieries, there would have been a mass of experience passed by the experts giving their attention to the matter, which would represent the public interest in the chances of profits on such an undertaking, and that was, after all, the real question—the present money value of such a chance. But this was practically the first case of the kind, and therefore they had no such experience to guide them. They were, in fact, in the position of being pioneers in making that very experience which some day or other might make a task like that an ordinary task, just like a valuation under the Lands Clauses Act of public-houses or other buildings. The only fact which might be regarded in the light of a public estimate of the value of

an undertaking of that kind was to be found in the price at which its shares stood in the market. He would not for a moment put that forward as conclusive, but it was the only thing of the nature of an estimate of its prospects. He must, first of all, consider the question of what was the prospective income before he dealt with the question of how that was going to be turned into present value. If he went to the tables which the company had put in it appeared to him that the apparent accuracy which their detailed character gave them was wholly delusive. The tables suggested that a person would give £64,000 for the profits of the undertaking in 1930. To that he would say that the undertaking had never been able to pay 4½ per cent. on the capital actually invested in it. Perhaps the last year or two, if they were to take off the useless capital—that capital that had not been already turned to profit-bearing use, it would just have done that; but if they put aside the proper amount for depreciation of capital that had been invested, he thought he was right in saying that it never yet had paid as much as 4½ per cent. on the capital issued. Yet it was represented there as being so profitable that the total claim in respect of about £500,000 invested was something like £2,700,000.

The Umpire asked Mr. Moulton whether he had formulated in his own mind what was the principle of value which he understood the claimants had put forward.

Mr. Moulton said he understood that they had taken the statistics in the past, and had estimated on certain hypotheses as to the continuance of increase of consumption in the future. They had also estimated the amount of extra capital that would be required to meet that consumption. They had then taken a certain percentage of that additional capital as representing what must be deducted from the future receipts to meet it. Then they had estimated the price that they would be able to charge in the future. They had also estimated on a certain hypothesis what the cost of that would be, and having got the net profit by subtracting from the price, the revenue derived from the sale, the cost, and secondly, the charges for additional capital, they got what they called the net profits of the year. Those they had valued as deferred payments, and to that they had added what they received in respect of that which was embodied in plant and buildings in the undertakings, the use of which was necessary for them in order to earn their income during the 30 years, and they had added to that a claim for severance because they said they were being cut off from Willesden.

The Umpire said that so far as he understood the underlying principles of the claimants' case, it was—leaving severance out of sight for the moment—that they asserted that they were entitled to the full present value of the whole of their net profits which the company would have received during the remainder of the term of its existence, plus the present value of such property as at the end of the term they would have been able to hand over to a successor.

Mr. Fletcher Moulton said he quite agreed, but he joined issue with the principle *in toto* if the words "present value" were used in any other sense than the price which a reasonable purchaser would give for it. In order to get some fairly accurate idea of the future scale of the company, they must first of all consider the probable scale of the business of the company. Witnesses on behalf of the company had put forward the contention that the business would consist of two important branches—the sale of electricity for lighting, and its sale for power. They had put forward the scale for lighting as some 25 million units per year, and for power eight million units. Those figures showed at once that they were hypothesising in the one case with a huge growth in the future, and in the other case a creation in the future. At present they sold something between four and five million units for lighting and practically nothing for power. They had been in existence over 11 years, and the total number of units sold for power in 1901 was not 80,000. They had come to those gigantic figures by a prophecy based upon the growth during the period of the existence of the company. They had looked at its growth, and imagined that, with certain adjustments, a growth of that type would go on in the future. He joined issue absolutely with the soundness of that method of calculation. Mr. Moulton then, at some length, went into the subject of the competition which electricity would have to meet with in the future for lighting purposes from incandescent gas, and said, with regard to the probable use for power, the important point to be considered was the price at which it could be profitably supplied, and in considering that question they were obliged to consider that a company would have to put plant down for their maximum demand. Reference had been made to storage batteries, but his witnesses would tell them that those storage batteries did practically nothing to relieve them of the obligation of generating their electricity at the moment they wanted it; all that storage batteries did was to allow them to shut down their machines at times when they had a very small demand. Therefore, in calculating the price at which power could be supplied, they would have to allow for capital charges for plant. Dealing next with the probable demand for power in Marylebone, the learned counsel said that the suggestions that had been put forward as to its being used for domestic purposes might be set aside, as the quantity so used would be very infinitesimal, and would all come at peak time. The only object which it might be said was more or less under the control of the suppliers, was the suggestion that it would be used for charging automobiles, but the difficulties there were very numerous. In the first place, automobiles did not exist, and it was very doubtful whether they would ever exist in large numbers. He pointed out that it would be impossible to charge automobiles in private yards, and that batteries would require very careful looking after. He should say that Marylebone would be one of the most difficult places in which to obtain large depôts, which would be necessary to supply power for automobile purposes. Mr. Ferranti had talked about the uses of electricity for heating purposes, but those uses did not exist, never would, and never could exist, on account of the relative high cost which would have to be charged in comparison with gas or coal.

Mr. Fletcher Moulton, continuing his address on Wednesday, August 6th, said he would next proceed to the question of the revenue and working cost of the company in the future. The question to be first considered was at what price the company sold the electricity they produced. With regard to that there was more than one complicated question. In attempting to judge the future price they knew perfectly well that prices of that kind had a tendency to go down in order to attract further customers, but in the present case they had not got that simple problem, because they had a case in which they must really look upon the prices as competitive prices. Whether or not a competitor was to divide the field, he claimed that they were entitled to the price which competition would have produced, because they had that clause in the agreement which substantially provided that the price in Marylebone should be the same as the price in the Strand. Of course, competition had the effect of sending down prices, because, do what they would, the companies bid against one another, and when they found there was such a difference between the price charged in Marylebone and the prices charged in the mid-London area as the difference between 4·4d. and 5·12d.—a difference of ¾d., or 15 per cent.—they saw results which it was not difficult to believe competition had had something to do with. He would liked to have heard Mr. Conacher's account of the reasons which led to those prices being charged in mid-London. Having traversed the evidence given on behalf of the company on the subject of price, Mr. Moulton said that like gas and water, electric light was a thing in which the business itself was no doubt of a speculative character, but taken as an undertaking, the quantum of the profits was highly speculative, and the consequence was that they must recognise that in using any figures as a guide to the price that they would offer for the company. What would a person coming in to take that business over and wanting to consider how he could carry it on and the profits he could get—what could he offer as the price? To ascertain that, let them see what the profits would amount to at the present time, if for the first five years they discounted it 5 per cent., the next 10 at 7½ per cent., and the next 15 at 10 per cent. He felt satisfied that a prudent man, considering the risks of that undertaking, the struggles with its physical competitor gas, the risks of other competitors getting leave to come in, would be entitled to do that. And also he ought not to forget a fact that had an influence upon the public mind as to price, viz., that the prices in municipal areas were unquestionably much lower than theirs. He said a prudent man would not be willing to look at far-distant profits much higher than that. He thought he would be able to satisfy the tribunal that that was a fair and reasonable estimate that a man would make before he offered a price. On the question of severance, it was common ground that if the Vestry were entitled to a self-contained supply, the claims for severance would go; but assuming, for the purpose of his argument, that there was no such right, he said that the tables put in by the company, and the figures on the point, were quite unsustainable. In their table the maximum demand in Marylebone, which was the figure on which all electricians made their calculations, was in 1901, 4,386 KW. Now they had put down generating plant, and then measured the difference in the area of supply by, of course, the weakest of the two elements of the generating plant in Marylebone, which happened to be the boilers, and they took 2,051 as being the deficiency. That figure was used to calculate the Marylebone proportion of the cost of generating and transforming plant at Willesden and of the requisite trunk mains. But that was an utterly hypothetical calculation, because the actual demand of Marylebone and Willesden, even at the maximum moment, was not represented by 2,051. As a matter of fact, they worked the stations just as was convenient. They used Willesden as much as they could, and Marylebone station practically only with the peak load. That, of course, was the meaning of the cheap generation at Willesden. Willesden had a station load factor of a very much higher figure than the Marylebone station, because almost all the non-peak load was done at Willesden, so that, of course, the cost of generation at Willesden did not really show the true cost of generation, because the excessive burden, the peak burden, was taken by those plants which were very much idle during the day. That was the way in which it had been worked, and that demand, both on the maximum day and other days, could not be calculated in any way from the actual plant—the amount of plant at the Marylebone station. If they turned to Table 22, on which a claim of something like a quarter of a million for severance was based, they found, "Extent to which Willesden can be used after 1902 for the purpose of the mid-London area, and also temporarily for the purpose of the Paddington area." The columns were calculated on the supposition that in the mid-London area the mid-London plant was working at its maximum, and the difference between that and the demand they put down to Willesden as being the only extent to which that could be used. As a matter of fact, not only could it be used to a larger extent, but it was habitually used to a larger extent. It was just in the same way with the Paddington area. Even at the peak time, the plant at Paddington, and, he believed, the plant in mid-London, was not doing its maximum, but at other times there was a perpetual and continual demand upon Willesden. Therefore the tables which had been put in were fictitious, and did not represent the real state of things. All they represented was the difference between the plant that was found at Paddington and mid-London, and the maximum demand in the year 1901 in those two places. The real guiding principle was the extent to which Willesden must have been used for mid-London, or

must be used for mid-London or for Paddington. They had found the amount of plant idle at Willesden by imagining that their other machinery in Paddington and mid-London was working at its full, although that was not true, and it never was so, and then they had taken the whole of that which would not then be used, and put that down to Marylebone without the slightest consideration of whether Marylebone had machines capable of doing any, and what part of it.

The Umpire said he would like to be clear on that point. If they looked at Table 22, Sec. B, they would see that the capacity at Willesden on December 31st, 1901, was 4,500 KW. The total used for Willesden in Sec. B was 1,063 KW. That would leave a balance, which upon the same method as was employed in Sec. B, would throw upon Marylebone 3,437 KW., but if they applied to Marylebone the same measure that they applied to the other areas, then they found from Table 14, A, that the use of Willesden for Marylebone would have been 2,051 KW. That, he understood, was Mr. Moulton's argument.

Mr. Fletcher Moulton: Yes, just so.

The Umpire: According to the method employed in Table 22, B, 3,437 KW. would have been taken as the use of Willesden to be thrown upon Marylebone.

Mr. Fletcher Moulton: Yes.

The Umpire: Whereas if you apply to Marylebone the same method that they applied to the other areas, then on their own figure, 2,051 KW. is all that is thrown upon Willesden.

Mr. Fletcher Moulton: Quite so. Continuing, he said that a striking example of that was obtained if they looked at the year 1905. The difference between 1905 and 1901 in output was, roughly speaking, 3,000,000 units, which would be 3,000 KW. The deficiency in 1901 was 2,000 KW. 3,000 and 2,000 would make 5,000, and if they looked at 1905, they put on them the obligation of using up 8,000 KW. The consequence was that they probably assumed that the machinery in the other areas was used to the full, and that Marylebone was responsible for using up everything else that happened to be in Willesden, and so in that year they made it responsible for taking 3,000 KW. beyond what its own machines would do—which was more than the total demand in Marylebone would be. In making such a table it was quite evident that they had taken in the Paddington area—that it must have a self-contained supply, and the consequence was that as soon as a certain time had elapsed, during which, they calculated they would be able to give a self-contained supply, immediately, according to their table, they threw loose and considered as unused, a vast amount of plant at Willesden. They flung the whole of that upon Marylebone, and they did it in a most thorough and most complete way. That was the principal part of their claim against the Vestry for severance, and when they came to look into the history of the installation of plant at Willesden, the case became really worse.

The proceedings were then adjourned.

(To be continued.)

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c. may be made. Answers are furnished by a duly qualified lawyer but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"OMEGA" writes: "The Board of Trade regulations state that aerial lines supplying electrical energy shall not be less than 18 ft. from the ground, or 30 ft. where they cross a street. Does this mean that a service line crossing a street direct from the aerial lines to a consumer's premises on the opposite side of the street is to be also 30 ft. from the ground? If so, it would mean (in the case of an overhead supply) that all the wires must necessarily be the same height. Would you kindly inform me what would be the approximate fee charged by the Board of Trade for the grant of a provisional order for the above."

*** It is provided in paragraph (18) of the Board of Trade Regulations that "An aerial line shall not in any part thereof be at a less height from the ground than 18 ft., or, where it crosses a street, 30 ft., or within 5 ft. measured horizontally, or 7 ft. measured vertically, from any building or erection other than a support for the line, except where brought into the building for the purpose of supply." The above rule applies to all aerial lines except those in the County of London, where lines must not be less than 20 ft. from the ground or less than 35 ft. from the surface of any street.

It is obvious that upon the true construction of this rule, so long as the limits are not exceeded, the wires may be at any height above the ground. The last sentence in the rule appears to answer our correspondent's query as to service lines.

As to the second half of his question, the expense of a provisional order could hardly be estimated from the figures which he has given us.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

16,664. "Improvements in or relating to trolley heads or collectors for electrically-propelled vehicles." M. MERCIER. July 28th.

16,680. "Improvements in and connected with electric adapters." H. OPPENHEIMER. (Actiengesellschaft Mix and Genest, Germany.) July 28th.

16,711. "An improvement in electrical conductors." SIEMENS BROS. AND CO., LTD. July 28th.

16,727. "Improvements in portable or table telephone instruments." L. M. ERICSSON. July 28th. (Complete.)

16,740. "Improvements in electro-magnetic motors and generators." A. ZEHDEN. July 28th. (Complete.)

16,750. "Improvements in the ventilation of enclosed electric motors and dynamo-electric machines." J. ECK. July 28th.

16,755. "Life-guard for electric or motor trams." W. GARNER and A. ROBERTS. July 28th.

16,764. "Improvements in electric time switches for cutting in or out of circuit at any desired time." H. L. P. BOOT. July 29th.

16,776. "An electrically-operated safety clutch for hoists." U. HORSFALL and J. CROWTHER. July 29th.

16,817. "A new or improved electric facia sign." A. GOLDSMITH and W. J. BOUGHTON. July 29th.

16,837. "Improvements in the framing of dynamo-electric machines and electro-motors." SIEMENS BROS. AND CO., LTD. (Siemens & Halske, Actiengesellschaft, Germany.) July 29th. (Complete.)

16,839. "Improvements in polyphase induction motors." SIEMENS BROS. AND CO., LIMITED, and F. LYDALL. July 29th. (Complete.)

16,843. "Improvements in and relating to clocks and particularly to electric clocks." J. BUTCHER. July 29th. (Complete.)

16,850. "Improvements in electric igniters for gas burners." H. BERGNER. July 29th.

16,852. "Improvements in perforators, more particularly for use with automatic telegraph transmitters." J. GELL. July 29th.

16,858. "Improvements in transmitting and utilising electricity." R. PAULSON. July 30th.

16,874. "Improvements in trolley-poles for electric tramways and the like." M. SMALL and C. KERR. (G. J. Thomas, United States.) July 30th.

16,896. "Improvements in electrically-controlled semaphore signals for railways." SIEMENS BROS. & Co., LTD. (Siemens & Halske, Aktien Gesellschaft, Germany.) July 30th. (Complete.)

16,904. "Improvements in or relating to regulating devices for dynamo-electric machines." H. H. LAKE. (General Electric Company, United States.) July 30th.

16,905. "Improvements relating to contact fingers for electric controllers." H. H. LAKE. (General Electric Company, United States.) July 30th.

16,906. "Improvements in electric circuit breakers." H. H. LAKE. (General Electric Company, United States.) July 30th.

16,923. "Improvements relating to the manufacture of incandescent electric lamps." H. H. LAKE. (General Electric Company, United States.) July 30th.

16,924. "Improvements relating to electro-magnetic switches." H. H. LAKE. (General Electric Company, United States.) July 30th.

16,925. "Improvements relating to the control of electric motors." H. H. LAKE. (General Electric Company, United States.) July 30th.

16,927. "Improvements in or relating to starting devices for induction motors." H. H. LAKE. (General Electric Company, United States.) July 30th.

16,928. "Improvements in counters, or tell-tales, for electric circuit-breakers." H. H. LAKE. (General Electric Company, United States.) July 30th.

16,939. "Improvements in or relating to apparatus for electric transmission, more particularly adapted for operating and controlling automatic type-setting and composing machines." J. LAGARDE. July 30th. (Complete.)

16,957. "An automatic safety appliance for overhead wires for electrical tramways." F. W. HAWDON. July 31st.

16,962. "Improvements in electrical switches or cut-offs." P. KENNEDY. July 31st. (Complete.)

16,981. "Combined sounding telegraph and telephone." C. NORDEN and A. H. ANDERSSON. July 31st. (Complete.)

16,983. "Improvements relating to rail connections for electric railways." H. H. LAKE. (Continuous Rail Joint Company of America, United States.) July 31st. (Complete.)

16,984. "Improvements relating to electrodes for secondary batteries." P. A. GOUIN. July 31st.

16,989. "Improvements in electric cables." W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED, and H. SAVAGE. July 31st.

16,992. "Improvements in or connected with signalling devices for electric tramways and other systems of electric traction." A. M. MARTIN and J. TENNANT. July 31st.

16,994. "Improvements relating to sectional conduits for electric wires and the like." W. L. MCGOWAN. July 31st.

17,002. "Improvements in the manufacture of electric conductors." V. LOWENDAHL. July 31st. (Complete.)

17,073. "Improvements in trolley systems for electric railways employing a surface rail." W. P. THOMPSON. (A. Watson, United States.) August 1st. (Complete.)

17,094. "Improvements in electric wall or floor coupling sockets." G. A. G. DAVIES, H. W. KENT, B. G. STEWART, and G. EWING. August 2nd. (Complete.)

17,106. "Improvements in and relating to overhead trolley lines or conductors, and the like." H. S. COWX. August 2nd.

17,111. "A new receiver for wireless telegraphy." L. H. WALTER. August 2nd.

17,127. "Improvements in or connected with underground conduits for electric tramways and railways." W. COPE. August 2nd. (Complete.)

17,134. "Improvements in holders for incandescent electric lamps." L. H. NEWTON and R. R. F. NEVILLE. August 2nd.

17,135. "Improvements in electric incandescent lampholders and switches." L. H. NEWTON and R. R. F. NEVILLE. August 2nd.

17,136. "Improvements in incandescent electric lamps." L. H. NEWTON and R. R. F. NEVILLE. August 2nd.

17,141. "Improvements in automatic electrical switches." A. S. ADLER. August 2nd.

17,142. "Improvements in automatic switches for electrical circuits." A. S. ADLER. August 2nd.

17,173. "Improvements in electric station indicators for use in connection with railway trains." F. LOSADI. August 2nd. (Complete.)